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BRONCHOGRAPHY IN AMPLIFICATION OF THE ROENTGEN FILM OF CHRONIC PULMONARY TUBERCULOSIS

WITH SPECIAL REFERENCE TO SURGICAL INDICATIONS*

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THE experiences I have had with bronchography as a diagnostic method in pulmonary tuberculosis compare with those in the study of lung abscess at Mount Sinai Hospital. In lung abscess, bronchography had been practiced for a considerable time, but it had not been adequately developed, and was thought to be of little value in the diagnosis. As the result of continuous investigation for several years we learned that it is an essential measure for the precise localization of the lesion and for a delineation of the part of the pathological process in which the bronchial tree is concerned. The group dealing with thoracic problems at Mount Sinai Hospital are now of the opinion that a case of lung abscess is not completely studied for purposes of operation if a bronchographic examination has not been made. This statement is made here because of the similar conclusion which I have reached with regard to pulmonary tuberculosis so far as surgical indications are concerned.

In chronic pulmonary tuberculosis the history, the physical examination and, above all, the roentgenogram, combine to offer a picture of the pathological process. An accurate interpretation from these data is often possible but a wide margin of error is very generally conceded. I propose to indicate that the margin of error can be reduced, and that the information derived from the roentgen film can be greatly amplified by bronchographic investigation. The opportunity to learn more of the nature and extent of the tuberculous lesion should be of general interest. Specifically, however, the present-day realization that the aim of treatment in chronic pulmonary tuberculosis should be the application of mechanical methods (which are methods of precision) will, in my opinion, place the bronchogram on a par with the roentgen film. This statement may appear to be an extreme one because our observations have not been spread over a large number of cases. In the material which has been studied, however, the information derived from bronchography has so often proved of definite value for the surgical indication (i.e., for the form of mechanical treatment to be applied) that there is every reason to assume that additional observations will confirm and expand the views to be presented.

The wealth of information to be derived from the roentgen film is taken for granted in this presentation and any stress placed

* From the Hudson County Tuberculosis Hospital, Secaucus, N. J. Read before the New York Roentgen Society, April, 1933.

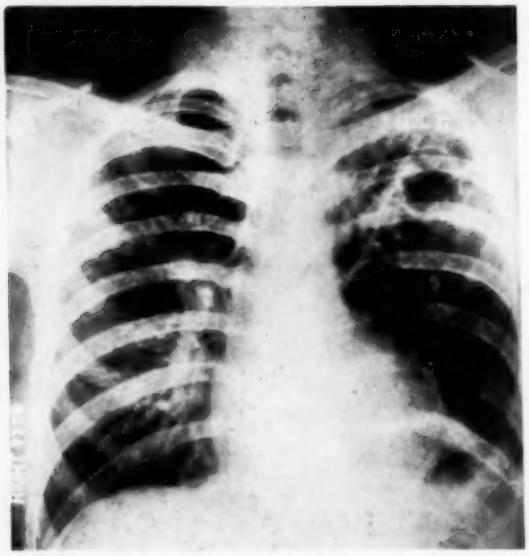

Fig. 1. L. S. Aug. 16, 1932. Cavity in left upper lobe. Mixed cavernous lesion.

on its limitations is not to be interpreted as adverse criticism of that sovereign method of examination. For purposes of mechanical treatment the roentgenogram in pulmonary tuberculosis is particularly expected to offer: (1) evidence of the presence or absence of cavity (its situation when present); (2) evidence of fibrosis, and of retraction in the affected lobe, and (3) evidence of the results of mechanical treatment by pneumothorax, phrenic nerve procedures, or cavity-collapsing operations. That the desired information in these directions is often obtained is well appreciated. It is equally true, however, that the roentgenogram not infrequently fails to supply such information or leaves so much room for doubt that varying interpretations can be made of the shadows which are seen. There are, besides, not a few instances in which the interpretation appears easy and clear and subsequently proves to be erroneous. These facts are too well known to roentgenologists for me to cite illustrative examples and I shall at once proceed with what I believe bronchography has to offer in amplification of the roentgenogram.

The literature on bronchography in pulmonary tuberculosis has been referred to by Dr. Murphy.* To recapitulate briefly, there are but few reports which have been made, and they consist essentially in a demonstration of cavity filling or of bronchiectasis of advanced grade before or after operations. No effort has been made to correlate the pathology indicated by the bronchogram with that in the roentgenogram.

Concerning cavities situated in the upper lobe (which after all comprise the essential feature of chronic pulmonary tuberculosis), it has been our experience that they are not readily entered by the radiopaque fluid, that they may be observed to fill during roentgenoscopy, but that they have emptied or all but emptied by the time the film has been taken. A small fluid level has been our maximal direct evidence of cavity. The indirect evidence of cavity in the bronchogram is of greater significance. It consists in the disposition of the bronchi and bronchioles around the site of cavitation, usually about its lower circumference. By their flattening, deformation, or dilatation as seen in the bronchogram they outline the

*See article on page 301.

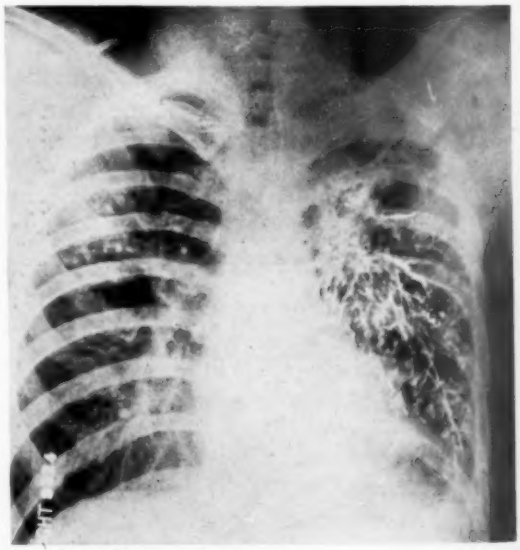

Fig. 2. L. S. Nov. 18, 1932. Lipiodol in cavity. Lipiodol fluid level in cavity (disclosed to be situated in relation to lateral branch of upper lobe bronchus). Contiguous bronchiectasis of paravertebral, postapical and lateral branches. Normal lower lobe.

situation and shape of the cavity. There is rarely any doubt as to the presence or absence of appreciable cavitation when a satisfactory bronchogram has been obtained. In a number of our cases the existence of cavities was definitely proved when the roentgen film presented areas of rarefaction not to be identified as cavities. The localization of the cavity to the upper or lower lobe is often readily made from the roentgen film, but there remains the group of cavities in the middle field in which localization to one or the other lobe may be difficult or impossible. That problem no longer exists when bronchography is done, for the relationship of cavity to the bronchi of the upper or lower lobe is clearly delineated.

Still greater accuracy in the localization of the cavity will become a requirement as the operative treatment of pulmonary tuberculosis tends more and more towards a direct attack in order to effect collapse of the cavity. The manner in which the bronchogram serves that purpose will now be indicated. A brief reference is necessary to some aspects of the pathology of pulmonary tuberculosis as I understand it. In the evolution of the tuberculous lesion a bronchopulmonary segment becomes involved, as in any other bronchopneumonic lesion. While cavitation can of course progressively invade several segments or a whole lobe, for that matter, the destructive process is primarily limited to a segment. Furthermore, the extension is from segment to segment, so far as bronchogenic spread is concerned. Pronounced destructive changes in the bronchus or bronchi of the cavity-containing segment are to be anticipated and that is precisely the disclosure of the bronchogram in the majority of cases. The bronchus leading to the cavity is dilated, distorted, and then is no longer visualized as if it had been cut off. The posterior apical segment of the upper lobe is the commonest original seat of the tuberculous lesion, with the paravertebral segment probably a close second. Most cavities extend over both of these segments. The paravertebral and apical bronchi are therefore the bronchi that usually present the gross

Fig. 4. A. C. Jan. 20, 1933. Lipiodol in cavity. Thin line of lipiodol fluid level in cavity. Ectasis of paravertebral and postapical bronchi with the latter of which the cavity is in relation. Normal lower lobe.

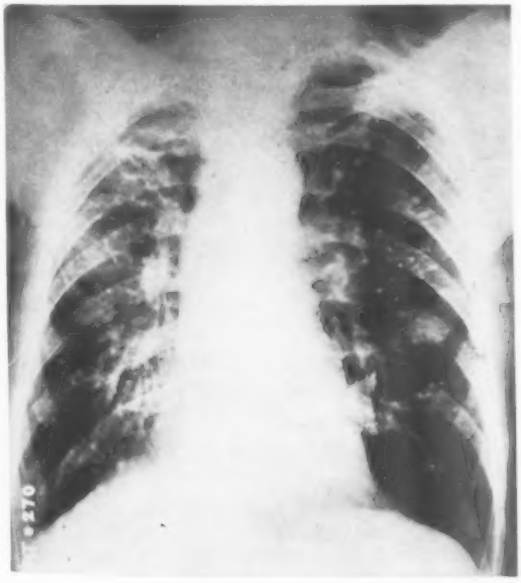

Fig. 3. A. C. Nov. 7, 1932. Cavity in right upper lobe. Mixed cavernous lesion.

abnormalities in the bronchogram to which I have referred. Since the bronchopulmonary segments bear a very definite relationship to the thoracic cage, it is clear that the

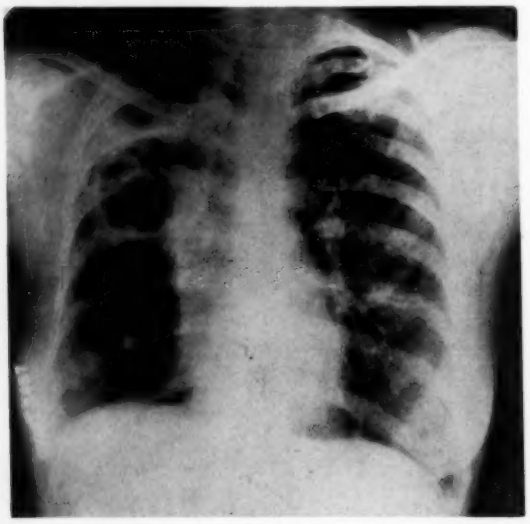

Fig. 5. A. M. July 18, 1932. Multilocular giant cavitation of right upper lung field. Small annular shadows in midst of cavitation. Honeycombing (?).

localization of the area of cavitation to specified bronchopulmonary segments is of real importance in the determination of the site of an operative approach to the lesion. As stated, the bronchial tree presented these obvious abnormalities in the majority of our cases which are for the most part instances of confirmed cavitation. There was but slight or no abnormality in the bronchogram in some of our cases. Further experience will probably lead to a differentiation in the indications for mechanical treatment between cavity cases with typical bronchial changes and those with slight or no changes.

Turning to the roentgen film of cavitation in the upper lobe, a frequent problem is the interpretation of additional smaller areas of rarefaction situated below the main cavity or cavities. These more or less circular moth-eaten defects are often termed cavities. One may then visualize the lobe of the lung as honeycombed with cavities, a condition which may defeat any effort at surgical collapse. A honeycombed lesion may indeed prove to be the fact. But the bronchogram will often present a surprising disclosure for it may demonstrate that the assumed numerous small cavities are only dilated bronchi. There is a high incidence of bronchiectasis in a lobe which is the seat of a confirmed cavity, and the dilatation and distortion of the bronchi are sometimes extreme and grotesque. This bronchiectasis in the pulmonary parenchyma about the cavity can usually be differentiated in the bronchogram from the diseased bronchus or bronchi going to the cavity.

Bronchiectasis in the lower lobe in the presence of an evident tuberculous lesion in the upper lobe is a separate subject which has received some recent discussion in the literature on the basis of bronchographic studies. One group asserts that these lower lobe bronchiectases are never tuberculous, the other group insists that they are always tuberculous. For the purposes of this presentation it will suffice to say that the

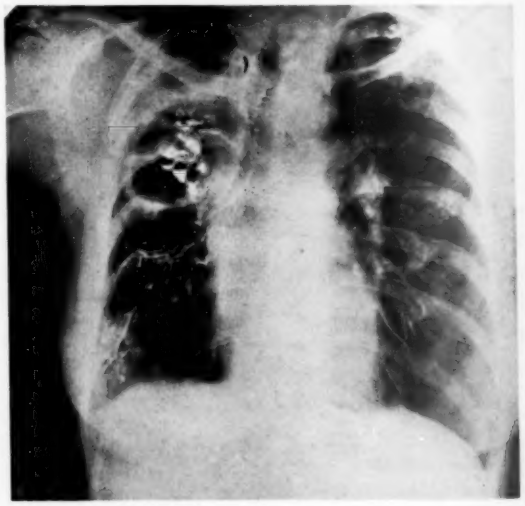

Fig. 6. A. M. Dec. 30, 1932. Bronchogram. Annular shadows shown to be saccular contiguous bronchiectasis of lateral and anterior branches of upper lobe bronchus.

roentgen film may demonstrate only slight or no abnormalities referable to such lower lobes whereas the bronchogram may reveal a grossly abnormal bronchial tree. In two

instances in our series the bronchiectatic lesions in the lower lobe were almost certainly tuberculous. The significance of an often unsuspected bronchiectasis in a lower lobe will in any event be apparent without further discussion.

Fig. 7. E. S. Extensive cavitation of left upper lung field. Marked tracheal retraction to the affected side.

An estimation of the degree of fibrosis in the tuberculous lobe is of paramount importance in the decision on the form of mechanical treatment to be employed. The roentgen film supplies the desired information in some instances but fails in others, and can readily be falsely interpreted in still other cases. The bronchogram usually sheds clear light on this question because it not only proves the existence of deformation and dilatation of the bronchi (indirect evidence of fibrosis) but also delineates the size of the affected lobe. In our experience a characteristic example is the roentgen film which portrays a cavity in the upper lobe with apparently limited fibrosis below it, the limit being a sharp curve whose concavity faces downwards. On the other hand, the bronchogram will demonstrate that it is in fact the whole upper lobe which is involved in fibrosis and that the curved line represents the lower limit of an upper lobe occupying a relatively insignificant part of the hemithorax.

Since fibrosis and retraction go hand in hand, the demonstration of a contracted lobe by bronchography is of great value in a visualization of the pathological process and therefore in the indications for mechanical treatment. It is safe to say that many futile phrenic nerve operations and not a few ineffective pneumothorax treatments would be avoided if bronchography were done before such procedures were carried out. Because occasional surprises are encountered I still adhere to the conventional principle of attempting pneumothorax before proceeding with cavity-collapsing operations. In my opinion, however, the time will come when the definite demonstration by bronchography of a retracted deformed lobe about the cavity will eliminate phrenic nerve operations and pneumothorax as procedures which would be useless, and will invite cavity-collapsing operations as the only type of mechanical treatment with a logical basis.

Fig. 8. E. S. Postoperative roentgenogram of pneumocavernolysis for this cavitation. Area of translucency under operative site. Tracheal retraction corrected.

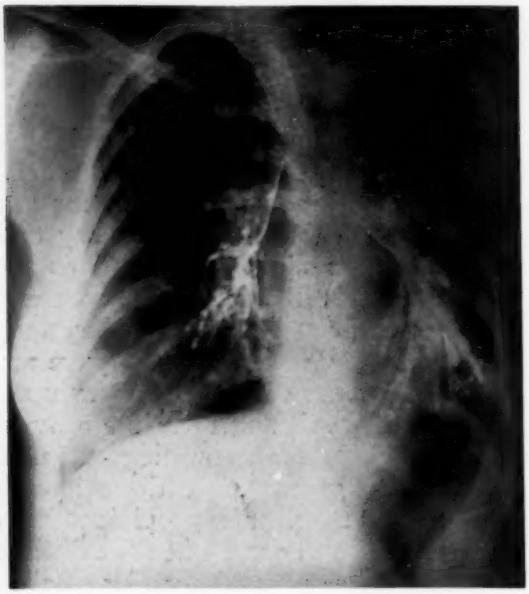

Fig. 9. E. S. Postoperative bronchogram. Area of translucency occupied by lipiodol-filled bronchiectasis. Cylindrical, glove finger bronchiectasis at homolateral base.

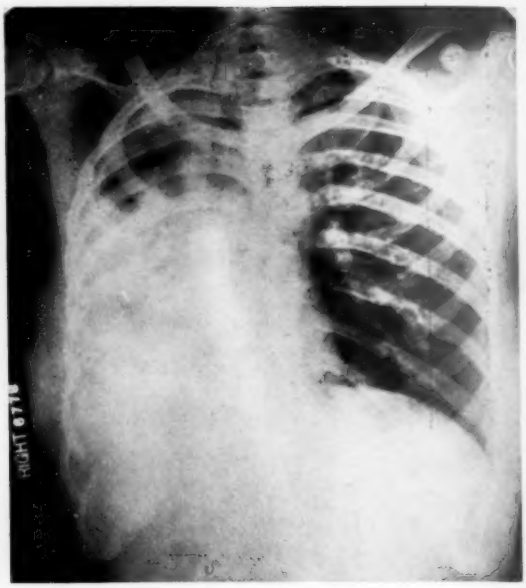

Fig. 10. W. B., colored. Jan. 27, 1932. Extensive cavitation in left upper lung field. Moderately homogeneous base. Marked "bayonet" trachea with sharp mediastinal displacement to the affected side.

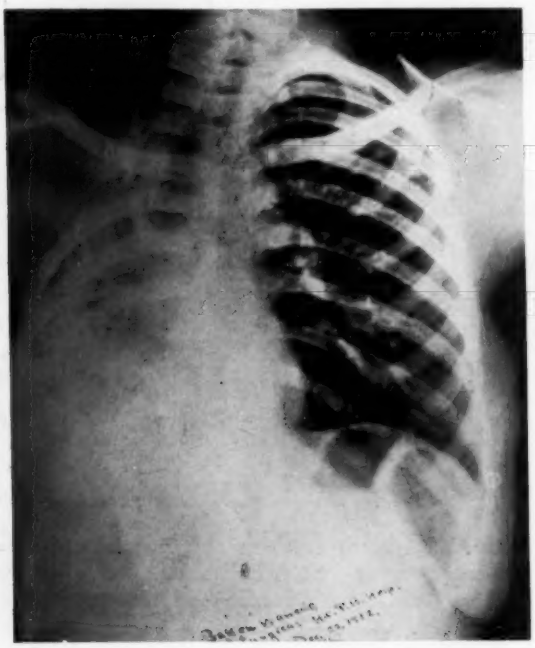

Fig. 11. W. B. Dec. 22, 1932. After pneumocavernolysis for cavitation. Translucency at base, suspicious of cavitation.

Fig. 12. W. B. Jan. 24, 1933. Postoperative bronchogram. Suspicious translucency shown to be gigantic sacculated bronchiectases. No residual cavity at operative site.

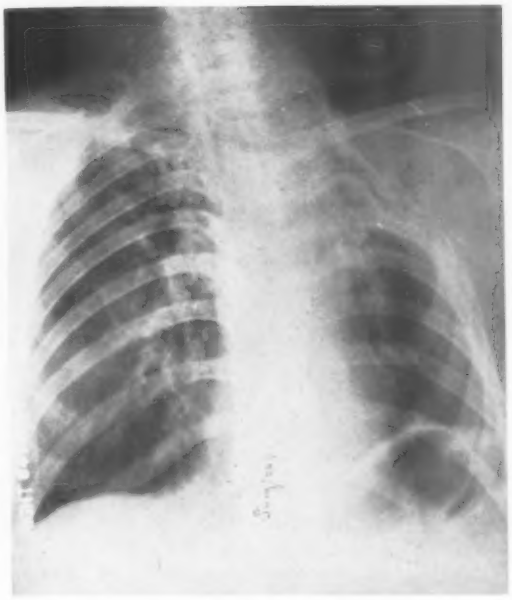

FIG. 13. J. B. Postoperative roentgenogram after pneumocavernolysis for left upper lobe cavitation. Translucent area, suspicious of cavitation, residual at operative site.

FIG. 14. J. B. Lipiodol film—postoperative bronchogram. Translucencies shown to be bronchiectases of postapical and lateral branches. No residual cavity. Basal bronchi normal.

FIG. 15. H. S. Postoperative film after pneumocavernolysis for left upper lobe cavitation. Translucent area at operative site suspicious of cavitation. (Incidental fluid level in soft parts of chest wall.)

FIG. 16. H. S. Lipiodol film—postoperative bronchogram. Showing translucent area occupied by crowded ectatic bronchi of upper lobe. No residual cavitation. Normal basal bronchi.

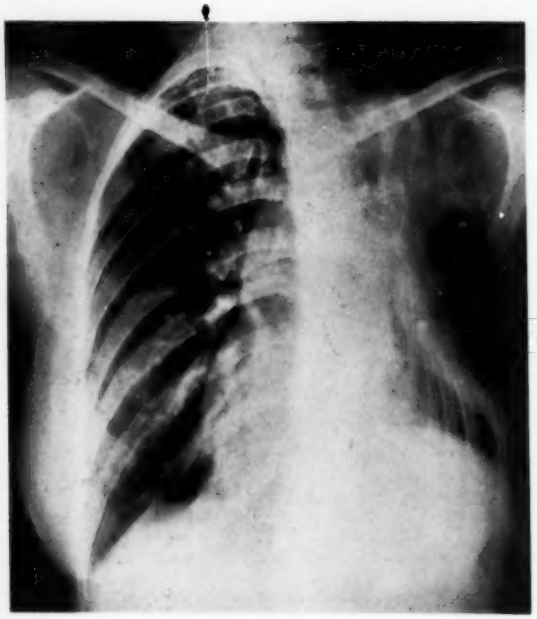

FIG. 17. E. N. Postoperative roentgenogram after two stages of pneumocavernolysis for cavitation of left upper lung field. Area suspicious of cavitation at operative site.

FIG. 18. E. N. Lipiodol film—postoperative bronchogram. Area shown to be bronchiectasis. Definite ectasis of bronchi which were contiguous to cavitation. Definite ectasis of bronchi of lower lobe.

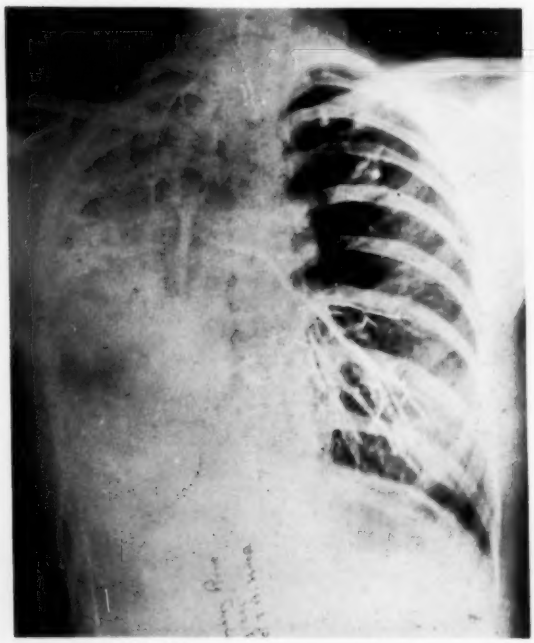

FIG. 19. R. S. Preoperative bronchogram. Cavitation in right upper lobe. Density at right base. Bronchiectasis contiguous (inferior) to cavitation. Marked mediastinal shift with "bayonet" trachea.

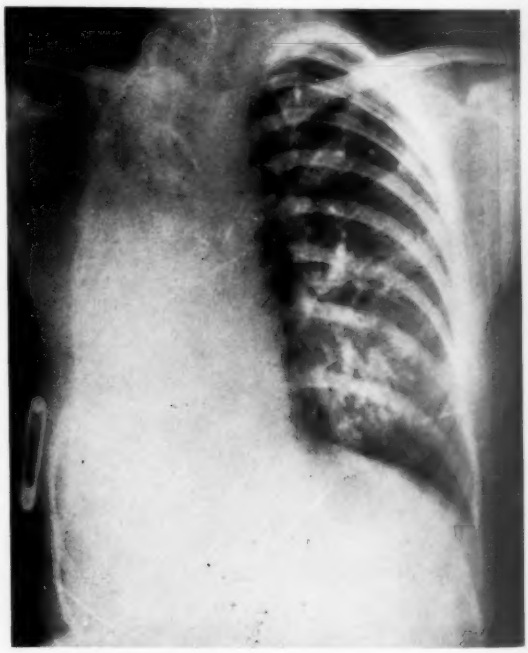

FIG. 20. R. S. Postoperative roentgenogram. After pneumocavernolysis. Film of operated side difficult to interpret. Areas suspicious of cavitation present at operated site and at base.

The last class of cases I shall refer to is the postoperative group. The two fundamental criteria of the efficacy of the mechanical treatment of pulmonary tuberculosis are the disappearance of tubercle bacilli from the sputum and the collapse of cavities. Evidence of both must exist before a result can be classed as satisfactory, and improvement after operation is of no lasting significance without collapse of a cavity and a bacillus-free sputum. The necessity for a demonstration of the collapse of a cavity is therefore clear. Physical signs are of no value for this purpose and complete reliance must be placed on the roentgenogram. The interpretation of the film is often fraught with great difficulty after any type of operative procedure on and within the thoracic cage. Lung markings are obscured, areas of rarefaction can be stressed or minimized, according to the reaction of the observer, and a homogeneous shadow does not prove the absence of cavity. Bronchography has much to offer in amplification of the postoperative film. As already stated, there are reports in the literature of its value in demonstrating cavities and bronchiectasis after operation.

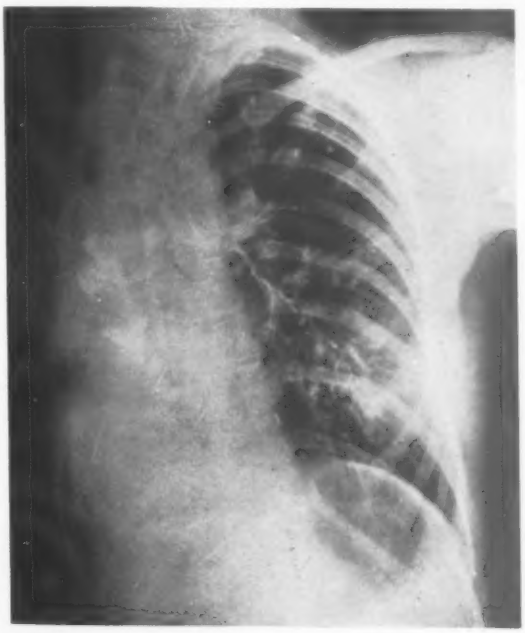

Fig. 21. R. S. Postoperative bronchogram. Suspicious areas shown to be gigantic bronchiectases. (Annular translucency in soft parts of chest wall.) No residual cavity.

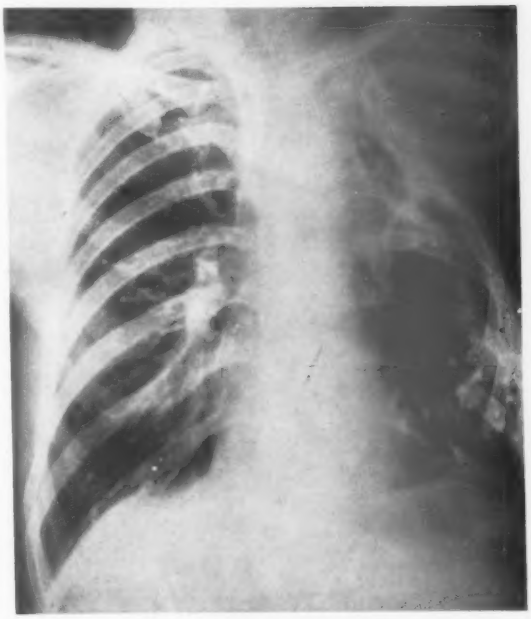

Fig. 22. J. M. Postoperative film after incomplete pneumocavernolysis for left upper lobe cavitation. Elongated annular shadow at operative site, suspicious of cavitation.

Fig. 23. J. M. Postoperative bronchogram. Shows definite fluid level in residual cavity. Contiguous ectasis.

Fig. 24. G. S. Cavity at left upper lobe. Pneumonic-cavernous lesion. Suspicion of lesion at right base. Pneumothorax over lower two-thirds of left lung.

Fig. 25. G. S. Bronchogram. Bronchiectasis contiguous to left upper lobe cavity. Adjacent bronchiectasis of drawn up branches of lower lobe. Saccular bronchiectasis at right base. Suspicious of lesion. Bronchoscopy showed tubercle bacilli coming from right lower lobe at this site.

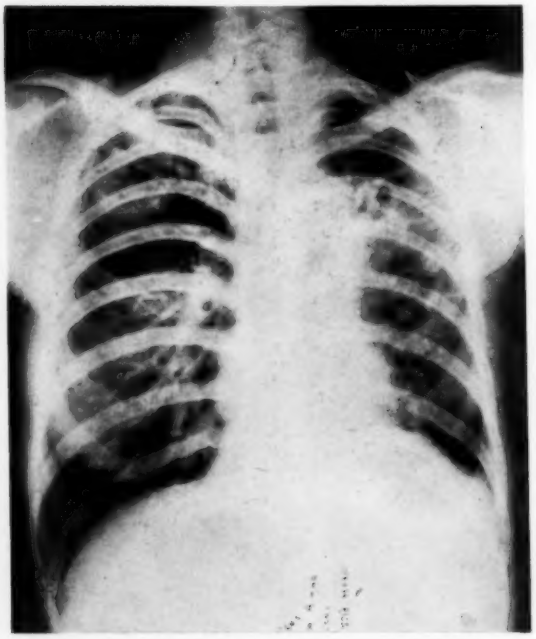

Fig. 26. A. S. Cavity in left upper lobe. Mixed cavernous lesion.

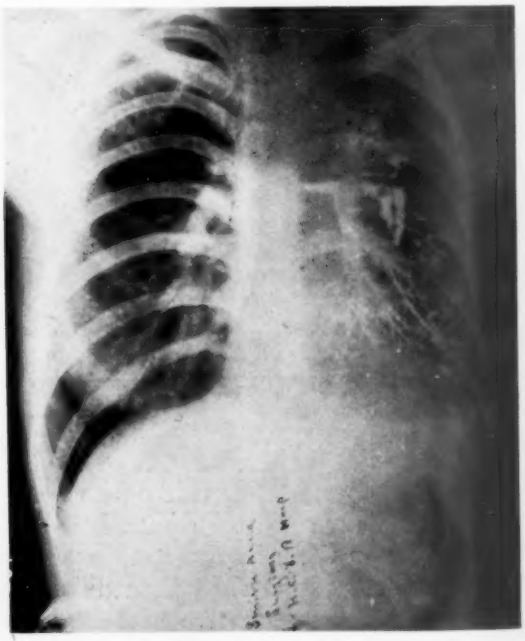

Fig. 27. A. S. Bronchogram. Bronchiectasis of paravertebral and postapical branches clustered about cavity. Contiguous bronchiectasis of lateral branches. Normal bronchi of lower lobe.

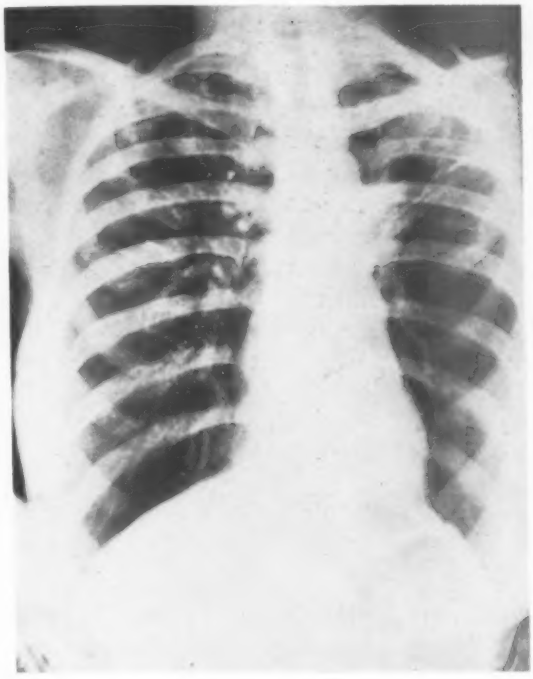

Fig. 28. R. E. Cavity in left upper lobe. Mixed cavernous lesion.

Fig. 29. R. E. Bronchogram. Excellent example of dilatation of paravertebral bronchus leading to cavity.

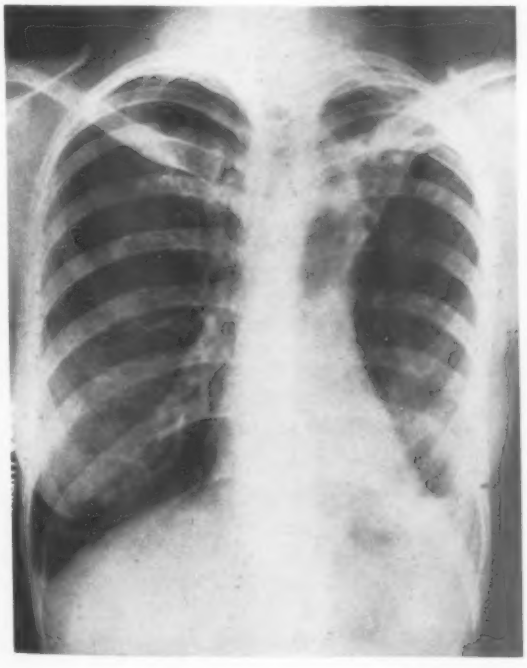

Fig. 30. M. H. Multilocular "honeycombed" area in left upper lobe. Cavity at apex. Contralateral pneumothorax.

Fig. 31. M. H. Bronchogram. Shows area to be composed of entire shrunken left upper lobe. "Honeycombing" due to ectasis of all bronchi of contracted shrunken upper lobe. Sharp lower border is the fissure marking lower limit of upper lobe.

These aspects of the postoperative bronchogram will therefore not be emphasized. It should be stated, however, that the presence of a cavity cannot be excluded because of non-visualization, for the same question of entry of radiopaque fluid exists after operation as before. The bronchogram does, however, delineate the non-collapse or collapse of parenchyma at the site of cavitation by the absence or presence respectively of a bronchial tree in that region. When cavities are not characteristically penetrated by the iodized poppy seed oil a small trickle may be observed at the suspected area of cavitation. Finally, the bronchogram is of aid in the interpretation of more or less clean-cut, small areas of rarefaction in the postoperative film. Some of these are found to represent uncollapsed cavities, others, dilated bronchi.

This brief survey of the value of bronchography in the interpretation of the postoperative roentgenogram is of little interest to those who consider the disappearance of tubercle bacilli from the sputum to be the sole measure of an operative result. An uncollapsed cavity, however, means active tuberculosis in its enveloping parenchyma in the vast majority if not in all cases. By the collapse of a cavity the enveloping tuberculous lesions are given an opportunity to heal. Operation has therefore failed, in my opinion, if the cavity has not been reduced to a slit-like cleft. Accordingly, the necessity for bronchography in the postoperative study, when the result is not well defined in the ordinary film, will be evident to those who believe, as I do, that the evidences of a result are to be determined by the collapse of the cavity as well as by the disappearance of tubercle bacilli from the sputum.

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BRONCHOGRAPHY, AN ESSENTIAL AND SAFE ADJUNCT IN THE STUDY OF PULMONARY TUBERCULOSIS*

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BRONCHIECTASIS has been recognized for many years, and as early as 1878 Grancher[3] described bronchiectasis and tuberculosis coexisting. Dilatations of the bronchial tree, either primary or secondary to other pulmonary disease, were observed repeatedly at necropsy but could not be demonstrated by clinicians until recently.

Jackson[6] in 1918 first outlined the bronchial tree by insufflation with bismuth powder through the bronchoscope. Lynah and Stewart[7] in 1921, using bismuth oil as a contrast medium, also outlined the tree. Several objections, chief of which was the nonabsorbability of bismuth, denied these methods popularity.

Forestier and Leroux[4] in 1923 applied lipiodol as a contrast medium in roentgenography. It gained immediate favor, especially in bronchography, because it is absorbable, nonirritating and unlikely to produce toxicity. Almost immediately it became a routine diagnostic procedure in suppurative bronchopulmonary diseases, but in most countries it was not given a place in the study of pulmonary tuberculosis, for apparently inadequate reasons. The French more than others applied bronchography to the study of pulmonary

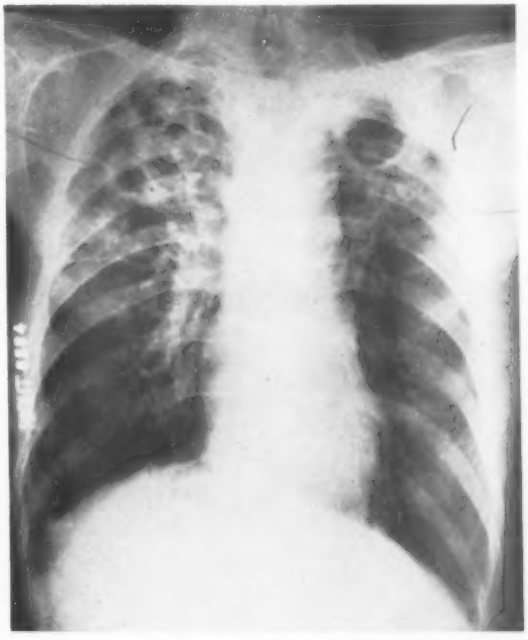

FIG. 1. Case 7984—Film 6534. Bilateral tuberculosis, right, mixed cavernous lesion, multiple cavities. Left, mixed cavernous lesion, single solitary cavity.

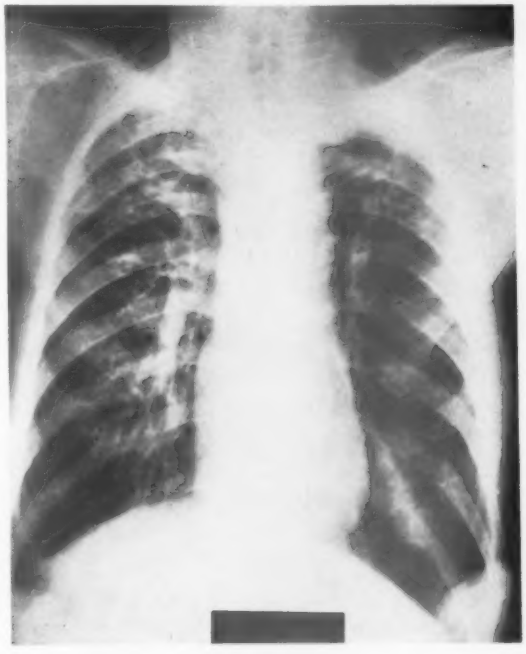

FIG. 2. Case 7984—Film 10027. Healing of cavities on right. Lesion is represented by a productive infiltration. Left, cavity indistinctly made out.

* Read before the New York Roentgen Society, April, 1933.

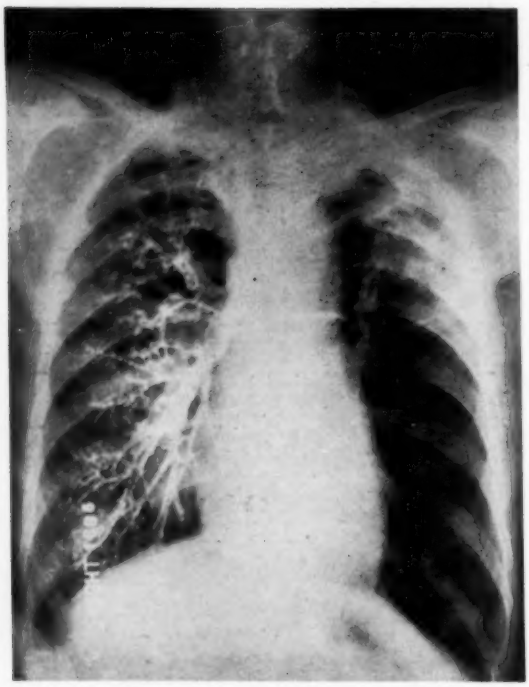

FIG. 3. Case 7984—Film 10085. Bronchogram showing some distortion of the secondary bronchi but no dilatation.

tuberculosis, and the French literature offers interesting and even surprising observations.

Armand-Delille, Simon,[3] and others, claim to have observed bronchiectasis in the site of the primary infection. Simon[3] claims to have observed this seven times in an unstated number of cases. He describes the dilatations as localized cylindrical.

Sergent, Rist, Bernard,[3] and others, have noted the frequency of the association of bronchiectasis and tuberculosis. Sergent[3] has noted that the apical dilatations are usually localized to a single bronchus, or branch of a bronchus, while lower lobe dilatations are more likely to be widespread. Apical dilatations, however, may be widespread and of any type.

Sergent has observed that all variations in the relationship may occur from extensive fibrosis without any dilatation, to widespread dilatations without any evidence of fibrous retraction; also that bronchiectasis may develop in any stage from the acute pneumonic to the fibrotic process.

Of the German school, Eliasberg and Neuland[3] have observed bronchiectasis in epituberculosis. Ranke and Hubschman have noted dilatations in the tissue between the primary infection and the hilus.

Unfortunately, only a few roentgenograms accompany the reports of bronchography in pulmonary tuberculosis so that we must depend almost entirely on the author's interpretation. This is a serious objection because, where the pathology as revealed by the bronchogram is not frank, there will be differing interpretations, and even definite pathology may admit of more than one interpretation.

American contributions to this subject have been few. Most important has been Ballon's[2] report of 50 injections of lipiodol, of which 13 were cases of tuberculosis. Unfortunately, his discussion of tuberculosis in this article is too brief but he draws attention to the value of the method as

FIG. 4. Bilateral pulmonary fibrosis, etiology undetermined. (Courtesy of Dr. B. S. Pollak.)

applied to surgery. Miller and Eglee[8] also point out the value of the bronchogram in differentiating cavity and bronchiectasis, and in evaluating the result of thoraco-

plasty. Geer, Callahan and Gardiner[5] also direct attention to this.

Because of the paucity of the literature and the inadequacy of roentgenograms, we have investigated this subject at the Hudson County Tuberculosis Hospital. At this time we wish to express our appreciation to Dr. B. S. Pollak, the Medical Director of the Hospital for his cooperation and encouragement, and to Dr. John Pagliughi, laryngologist, for assisting us in the work. A comprehensive study has not been completed, but present results have convinced us that the procedure is essential in a more complete study of the pathology of tuberculosis, and is indispensable in some cases.

TECHNIQUE

We employ the intratracheal route,[9] and would call attention to the following departures from the conventionally described method:

1. The anesthetic—A 2 per cent butyn spray gives anesthesia as far as the larynx;

Fig. 5. Same case as Figure 4 with bronchogram of right side showing the entire right bronchial tree elevated and swept laterally by fibrosis. No dilatation. (Courtesy of Dr. B. S. Pollak.)

20 per cent cocaine on swabs is applied directly to the pyriform fossae, epiglottis and cords.

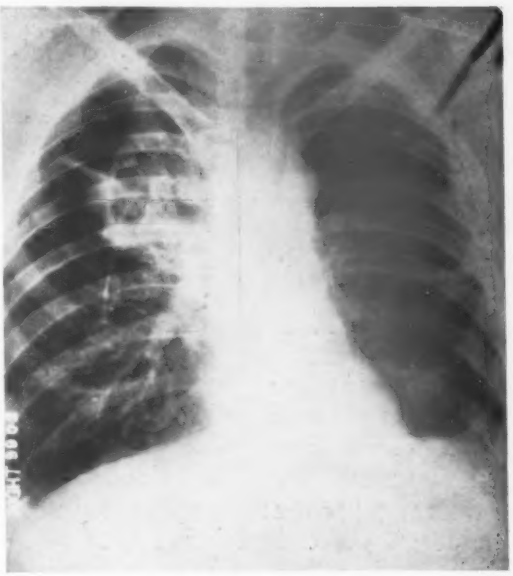

Fig. 6. Case 7795—Film 9902. Left, productive infiltration. Right, partial pneumothorax, mixed cavernous lesion of the right upper lobe, cavity held open by adhesions.

2. The catheter—No. 12 French rubberized silk is introduced intranasally, which gives better fixation in the trachea with consequently less irritation.

3. Posture—The posture is correct when the part to be investigated is dependent.

4. Lipiodol—The amount used rarely exceeds 15 c.c.

5. Site—The region to be investigated is selected from the plain plate and the lipiodol introduced here only—so-called selective bronchography.

6. Roentgenoscopy—Lipiodol is injected under roentgenoscopic observation. Under the roentgenoscope one can note bronchial mobility and can see lipiodol directly entering cavities.

7. Roentgen technique—An overexposed film is taken for better contrast. It is desirable but not essential to make the exposure before the patient changes position.

RESULTS

Up to this time 99 injections of lipiodol have been done in pulmonary tuberculosis. Because the procedure was repeated postoperatively in some cases, and the tech-

nique or cooperation gave poor results in others, only 65 cases are chosen for analysis. The results are as follows:

	Mixed Cavernous	Fibro-cavernous	Caseo-cavernous	Infiltra-tration	Healed Cavities	Total
Bronchial dilatation	27–73%	9–60%	1–25%	3–43%	0–0	40–61.5%
No dilatation	8–21.6%	3–20%	3–75%	4–57%	1–50%	19–29.3%
Suspicion of dilatation	1– 2.7%	0–0	0–0	0–0	1–50%	2– 3.1%
Distortion of bronchi	1– 2.7%	3–20%	0–0	0–0	0–0	4– 6.2%
	37	15	4	7	2	65

Of the 65 cases studied, 56 were cavernous lesions of one type or another. Of these, 66 per cent showed definite bronchial dilatation; 7 per cent bronchial distortion without dilatation and 2 per cent a suspicion of dilatation. In this series mixed cavernous lesions showed the highest incidence of bronchial dilatation, 73 per cent; fibrocavernous, 60 per cent, and caseocavernous, 25 per cent.

Infiltration showed a remarkably high incidence of 43 per cent bronchial dilatation. The infiltrated lesions showing this dilatation were all predominantly productive.

FIG. 7. Case 7795—Film 10101. Bronchogram, expiratory phase, shows some scattered dilatation in branches of right upper lobe bronchus.

In 6.2 per cent of the cases there was distortion of bronchi with no attending dilatation. All were associated with changes in lobe volume and were probably due to fibrosis.

In 80 per cent of the 40 cases showing bronchiectasis the dilatation was confined to the upper lobe, and in the remaining 20 per cent, two or more lobes were involved. The involvement of more than one lobe was as frequent in caseocavernous as in fibrocavernous lesions. Occasionally there is encountered a proved case of tuberculosis confined to one lower lobe with attending bronchiectasis. Dr. A. E. Jaffin, Chief of Clinics of Jersey City, recently presented such a case at one of our conferences.

In 25 per cent of the 56 cases of cavitation, the cavities were penetrated by lipiodol. With improvement in technique we are more successful in entering cavities.

A lower lobe, retracted so that it is represented on the roentgenogram by a small triangular area of density in the cardiophrenic angle was observed in 5, or 7 per cent, of cases. Of these, 4 showed bronchial dilatation in the retracted lower lobe. Bronchogenic spill over of tuberculous infection could be associated or proved in 4 cases. Spread was from the contralateral lung in 2 cases.

VALUE

We deem bronchography essential in:

1. Interpreting the pathology of tuberculosis:

(*a*) Because bronchial dilatation is so frequently present in tuberculosis, and since it may simulate the roentgenographic manifestations of parenchymal disease, it

is frequently necessary to differentiate the two if one is to apply rational therapy.

(*b*) Baffling areas of density and rarefaction may be resolved into a logical part of the pathological picture.

2. In the surgery of tuberculosis:

It enables one to differentiate parenchymal cavities from bronchial dilatation, and where selective collapse is to be practiced it enables one to determine the lobe involved and to localize cavity accurately.

3. Clinically, it may enable one to explain productive cough with negative sputum.

LIMITATIONS

We desire to call attention to the following limitations of the procedure as practiced by us:

1. Difficulty in penetrating cavities due to diseased, tortuous bronchi, containing secretion obstructing the lipiodol. Ballon reports greater facility with the bronchoscopic method but it is more trying on the patient. We would reserve this method for the few cases in which the pathological process cannot be determined from the results obtained by the less formal method.

2. Secretion in healthy bronchi will prevent filling so that mere failure to fill does not indicate disease.

3. As pointed out by Sergent, the relatively small amount of lipiodol used may not penetrate the diseased area, so that a negative result does not rule out disease.

4. Apparently slight dilatation of the bronchi in the conventional inspiratory phrase may be incorrectly interpreted as pathological, when the expiratory phase may reveal a normal tree.

CONTRAINDICATIONS

Sicard and Forestier[9] give the following contraindications to bronchography:

1. Acute pulmonary tuberculosis accompanied by fever.

2. Debility of the patient rendering the extra exertion inadvisable.

3. Following recent hemorrhage, he advises waiting eight to ten days. We wait for a few weeks and have had no recurrences of hemorrhage.

Fig. 8. Case 7795—Film 10101. Bronchogram, inspiration. Notable feature in this is the marked widening of the bronchi on inspiration.

It appears remarkable, when one considers the frequent association of tuberculosis and bronchial dilatation, and the inability to differentiate the two on ordinary films, that bronchography has not been applied widely to the study of tuberculosis, especially when surgery is contemplated. When one considers the good repute the procedure enjoys in other bronchopulmonary diseases, he must attribute this omission to a hesitancy to employ an iodine preparation in the presence of pulmonary tuberculosis.

It is not my desire, nor do I consider it necessary here, to enter the highly controversial discussion of iodine preparations in tuberculosis. Lipiodol is a true chemical compound of iodine with unsaturated fatty acids. Following introduction intratracheally most of it is expectorated. The remainder is gradually broken down and absorbed. The rate of absorption is comparatively slow, so that, according to Sicard and Forestier who have investigated the excretion of the iodine, an average of 3 grains per

day, with our dosage, would be eliminated during the first ten days. Totally negligible amounts are eliminated for some time after. This small amount of iodine is insufficient to influence the course of a given case of tuberculosis, unless a patient is hypersensitive.

Archibald and Brown[1] have reported a fatal case of tuberculous bronchopneumonia in the left base following lipiodol injection. The case report, however, reveals that the patient had a low fever and the signs of active tuberculosis in the same hilar region. We would not consider this a case for bronchography.

In our series of 99 cases, 3 patients have had transient febrile reactions. All these were more or less debilitated and we feel that this debilitation exerted a greater influence than any other factor. Of the three, two were anatomically progressive without clinical manifestations and one was a fibrocavernous lesion. One patient had a massive edema about the face and eyes a few hours after injection. This responded readily to adrenalin. Check-up roentgenograms at varying intervals following lipiodol injection have revealed no progression of lesions.

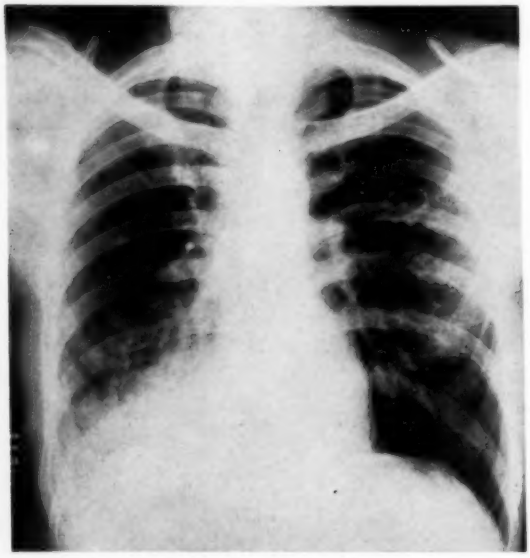

FIG. 9. Case 8758—Film 11011. Bilateral pulmonary tuberculosis, sputum positive, exudative cavernous lesion from the second to the fifth anterior ribs on the left with cavity in the second interspace. Right side shows apparently dense infiltration right lower lobe.

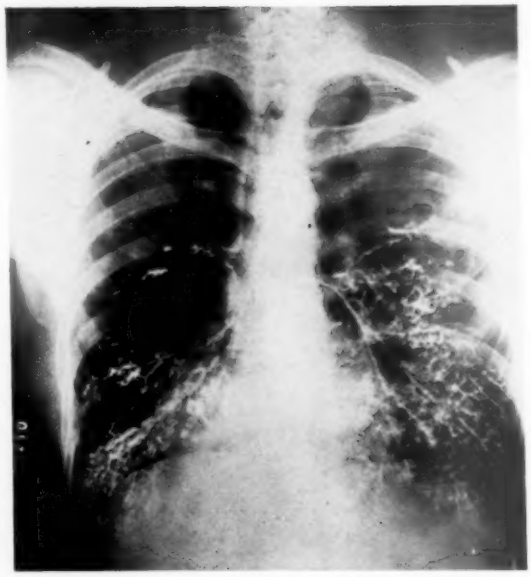

FIG. 10. Case 8758—Film 10210. Left, cavity penetrated by lipiodol shows fluid level. The left lower lobe bronchial tree is normal. Right side shows retraction of the right lower lobe and some retraction of the right middle lobe. The density on the plain film is accounted for by the reduced volume of the right lower lobe. The bronchial tree is patent. No dilatation present.

SUMMARY

Ninety-nine injections of lipiodol in cases of pulmonary tuberculosis have been done by us with no major complications. Three transient febrile reactions and one case of massive edema occurred. The three febrile reactions were in debilitated patients.

Bronchial dilatation was observed in 60 per cent of 65 cases ranging from infiltration to fibrocavernous lesions. Variability in the association of bronchial dilatation and tuberculosis, as observed by Sergent, was noted in the series.

Bronchial dilatations of all types and extent, which could not be differentiated from parenchymal lesions on the ordinary film, were clearly defined on the bronchogram.

CONCLUSIONS

Tuberculosis in the majority of sanatorium patients is a bronchopulmonary rather than a pure pulmonary disease. The bronchial element can be recognized only on the bronchogram. Hence it is essential to outline the bronchial tree if the bronchopulmonary pathology is to be interpreted correctly and rational therapy applied.

NOTE: Since this paper was written, Dr. M. Joseph Mandelbaum, New York, has informed us by personal communication that he has done 250 lipiodol injections in 90 patients with no serious complications.

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BRONCHOGRAPHY IN RELATION TO THE PATHOLOGY OF PULMONARY TUBERCULOSIS*

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THE introduction of roentgenology in the study of pulmonary tuberculosis marked a step forward in our comprehension of the disease. Hitherto our study of tuberculosis in the human depended upon post-mortem observations which, while picturing most phases in the evolution of the disease from incipiency to termination, did not in any case permit chronological studies. With the advent of the roentgen ray, however, it became possible by serial films, to trace the pathological changes from the conglomerate tubercle to cavitation, resolution, fibrosis and calcification. There followed a period of enthusiasm that involved an overvaluation of the plain roentgenogram. The addition of stereoscopic views and exposures at different angles indicated for the first time the limitations of the ordinary plate. Then came the notable papers of Sampson, Heise and Brown,[7] Amberson,[1,2] Dunham,[4] and many others, in which attempts were made at the interpretation of the densities cast by the roentgen ray, but with such differences of opinion as to focus attention on the shortcomings already noted.

Except for improvement in equipment and technique, which merely gives clearer definition to the same shadows, no progress has been made. Unanswered problems rendered it necessary, therefore, to supplement roentgenography in order that one might proceed more surely in the conduct of a case.

The satisfactory results with bronchography in non-tuberculous diseases of the chest seemed to indicate that its application might yield indisputable evidence where the plain roentgenogram furnished insufficient information.

The cases studied divide themselves into clearly defined groups, each one of which represents a problem in pathology which, unless correctly interpreted, would place both physician and patient decidedly at a disadvantage.

Group 1. Bronchiectasis in Tuberculosis. That widening of the bronchial tree can and does occur in tuberculosis, especially of the fibroid type, is generally recognized. How frequently the two conditions are associated is difficult to state from available reports. Post-mortem studies by Norris and Landis[6] in 197 consecutive cases of tuberculosis revealed bronchiectasis in 22.1 per cent. Practically all observations on this subject with lipiodol have been confined to differentiating suppurative bronchiectasis from tuberculosis. The small number of cases in the literature of bronchial dilatation associated with tuberculosis thus depicted does not give a true analysis of frequency. From our own studies, however, we must conclude that the incidence is high in the chronic fibro-ulcerative lesions.

In fact, if Macklin[5] is correct, changes in the bronchial tree should be expected in all cases of tuberculosis. He wrote: "It should be clear that the bronchial tree with its attendant structures include the entire lung. What we call 'lung' is only the complex of peripheral twigs and 'leaves' of the tree, closely dovetailed together, with their connective tissues, blood and lymph vessels and nerves." In addition we have the belief of Birsch-Hirschfield quoted by MacCallum,[4] that "progressive pulmonary tuberculosis must start in a tuberculous ulceration of the wall of a small bronchus going toward the apex, and, indeed, we have occasionally seen this."

Let me stress that lack of recognition of

* Read before the New York Roentgen Society, April, 1933.

bronchial changes (often playing the predominant rôle in the formation of shadows seen in the roentgenogram) is responsible for the bizarre interpretation given to these shadows by roentgenologists and clinicians.

The cases in this group exemplify lesions which, if interpreted in terms of parenchymal pathology alone, could be variously and incorrectly read as fibro-ulcerative infiltration, honeycombed lobe, or inclusion of normal parenchyma in a fibroid infiltration. Bronchography, however, reveals the pathological process to be primarily bronchial rather than parenchymal, and so enables one to account for the symptoms of cough, productive of negative sputum.

Group 2. Interpretation of Annular Shadows. In 1919, Sampson, Heise and Brown[7] initiated a series of discussions on the meaning of annular shadows so often seen on roentgenograms of moderately and far advanced cases of pulmonary tuberculosis. It is needless to go into a discussion of the various views. Suffice it to say that, while the great majority of such rings are cavities, there is ample evidence that pleural pockets, encapsulated pneumothoraces and emphysematous blebs may cast similar shadows. The importance of certainty of differentiation becomes apparent when one remembers that, except in few instances, cavities must be attacked actively by some form of collapse at the optimum time.

We start with the premise that failure to induce a fluid level within a ring shadow with lipiodol does not signify absence of cavity, yet we know of no more positive evidence of cavitation than when the converse is true. The ring shadows that require differentiation are those within which there are lung markings of the same or different density than the surrounding lung parenchyma and those which present a very clear-cut inner border with no parenchymal delineations.

Group 3. Localization of Pathology. The extent of pathology seen on the roentgenogram is usually described with reference to vertebrae or ribs. For general purposes this is satisfactory. Occasions arise, however, especially when surgical intervention is contemplated, when exact localization of the infiltrated process is desired. At times we are assisted in this by pleural fissures though with no assurance that we are correct. Retraction of a lobe, a frequent occurrence in the course of pulmonary tuberculosis, may displace these lobar boundaries far from their normal position and render their evidence misleading. The only way then definitely to define a lobe is by outlining its bronchial ramifications with an opaque medium. The cases in this group demonstrate this point.

Group 4. Differentiation between Pleural and Parenchymal Pathology. The frequency of pleural involvement in pulmonary tuberculosis is accepted. The pleural changes may cast shadows on the roentgenogram which may obscure the entire lung field or render difficult the recognition of the more important parenchymal pathology. Hydropneumothorax, a frequent sequel to artificial pneumothorax, may add to this difficulty.

The paramount importance in this differentiation is the aid it gives in arriving at the correct diagnosis which dictates rational therapy.

Group 5. Differentiation between Densities Cast by Unaerated Lung and Similar Densities Due to Other Causes. Often one is confronted with a roentgenogram in which a hemithorax is masked by a homogeneous density, one or more of the mediastinal structures is retracted to the affected side, and the diaphragm is excessively elevated. In a few of our patients undergoing pneumothorax treatments, we have noted a loss of lung markings in the partly collapsed lung which became replaced by such a density.

We have seen similar diffuse densities produced by pleurisy with or without effusion, and by a thickened pleura with a secondary reduction of lung volume as is shown in Case 1, Group 4.

Bronchoscopy, as in the case described in this group, may reveal a patent main

bronchus. Lipiodol injection, however, will show lack of distribution of the oil beyond the main radicles of the bronchus supplying the involved lobe. Such evidence clearly explains the density described above as due to unaerated lung. This has a clinical bearing when a case of this type is considered for formal surgery.

CONCLUSIONS

In conclusion, it may be safely stated that:

1. Pulmonary tuberculosis is a broncho-pulmonary disease with associated pleural changes.

2. The shadows cast by these structures cannot always be dissociated unless the plain roentgenogram is supplemented by bronchography.

GROUP I CASES

Case I (No. 8723). W. B., male, aged twenty-nine. Duration of illness two years. Sputum negative, positive on admission.

Symptoms. Productive cough, frequent small hemorrhages.

Roentgen Findings. Pathology in question is that of right upper lobe which shows productive infiltration interrupted by numerous small rarefied areas which in the bronchogram are occupied by dilated branches of the upper lobe bronchus (Figs. 1 and 2).

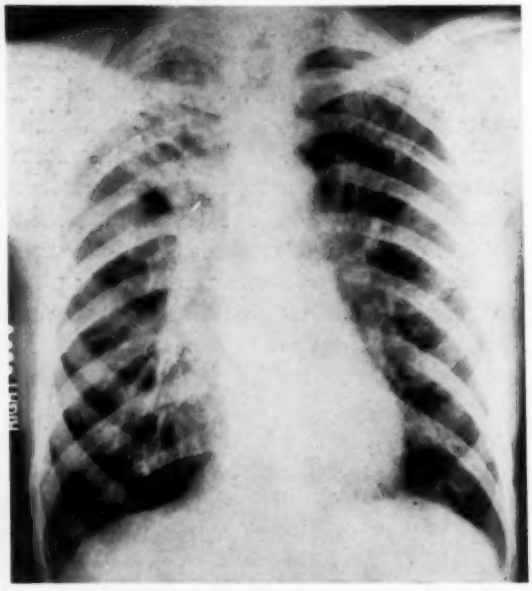

Fig. 1. Group 1. Case 1. Plain roentgenogram.

Fig. 2. Group 1. Case 1. Bronchogram.

Case II (No. 8410). M. D., aged twenty-four. Entered hospital two and a half years ago with a bilateral upper lobe caseocavernous lesion and positive sputum. On routine care cavities have closed and infiltrative process, especially in the left upper lobe, has shown marked clearing.

Present Symptoms. Occasional cough, productive of negative sputum.

Present Roentgen Findings. Patchy, productive infiltration in both upper lobes, more extensive in the right where there are numerous areas of high light. Bronchogram shows these rarefied areas to be dilated twigs of the upper lobe bronchus, and so explains symptoms (Figs. 3 and 4).

Case III (No. 8741). H. V., male, aged forty-two. Duration of illness five years. Sputum negative, positive at one time.

Symptoms. Productive cough, loss of weight, fatigue.

Roentgen Findings. Bilateral productive infiltration interlocking numerous less dense areas confined to the upper lobe. Bronchogram limited to the left side reveals bronchiectasis and a cavity (not demonstrable in the plain plate) as outlined by a horizontal lipiodol level (Figs. 5 and 6).

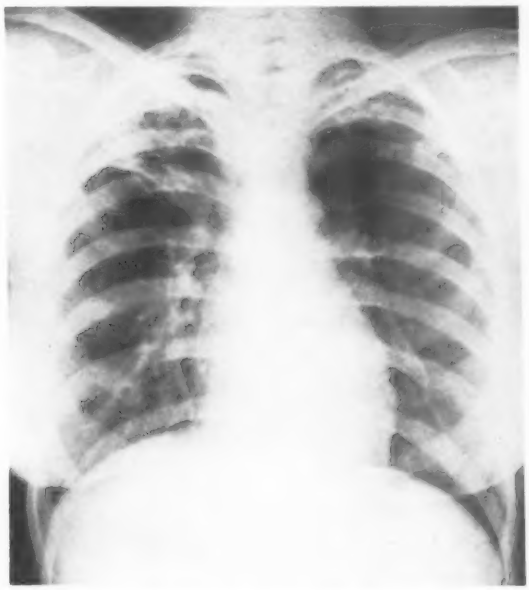

Fig. 3. Group 1. Case II. Plain roentgenogram.

Fig. 4. Group 1. Case II. Bronchogram.

Fig. 5. Group 1. Case III. Plain roentgenogram.

Fig. 6. Group 1. Case III. Bronchogram.

GROUP 2 CASES

Case I (No. 8745). H. S., male, aged twenty-nine. Duration of illness eight years. Sputum negative, positive at one time.

Symptoms. Productive cough, loss of weight, anorexia.

Roentgen Findings. Left lung relatively clear. Trachea deviated to the right. There is a stringy infiltration extending from the upper pole of the right hilus toward the axilla in the second interspace leading to an annular shadow the size of a quarter, presenting linear markings within its border, the density of which is no different from that of the surrounding parenchyma. There is a pleural fissure dividing the middle from the lower lobe. The cardiophrenic

Fig. 7. Group 2. Case 1. Plain roentgenogram.

Fig. 8. Group 2. Case 1. Bronchogram.

angle is obliterated by a triangular shadow with its base at the inner third of the diaphragm. Bronchogram shows a lipiodol level in a ring shadow and explains the triangular shadow as due to bronchiectasis. The pleural fissure is between the upper and middle lobes and not as thought, from the plain plate, between the middle and lower lobes (Figs. 7 and 8).

Case II (No. 8520). F. B., female, aged twenty. Duration of illness six years. Sputum negative.

Symptoms. Productive cough.

Roentgen Findings. Left, selective pneumothorax collapse confined to the left upper lobe. Right, small pneumothorax over right upper lobe. Stringy infiltration extending from the

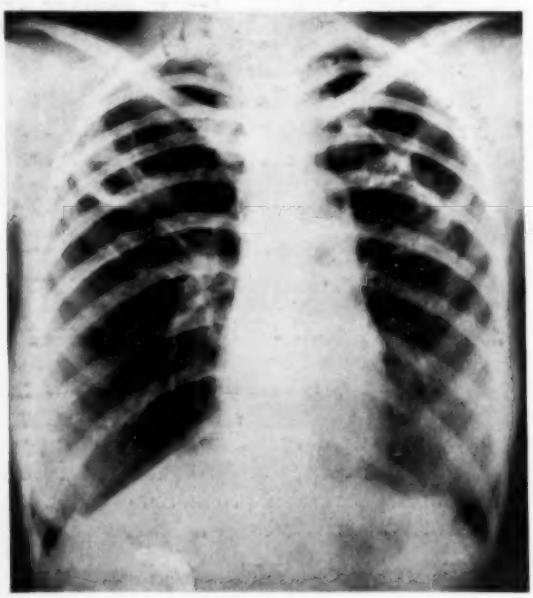

Fig. 9. Group 2. Case II. Plain roentgenogram.

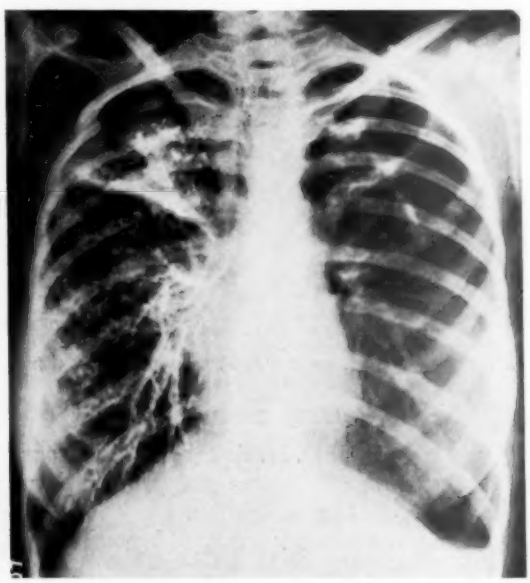

Fig. 10. Group 2. Case II. Bronchogram.

Fig. 11. Group 2. Case III. Plain roentgenogram.

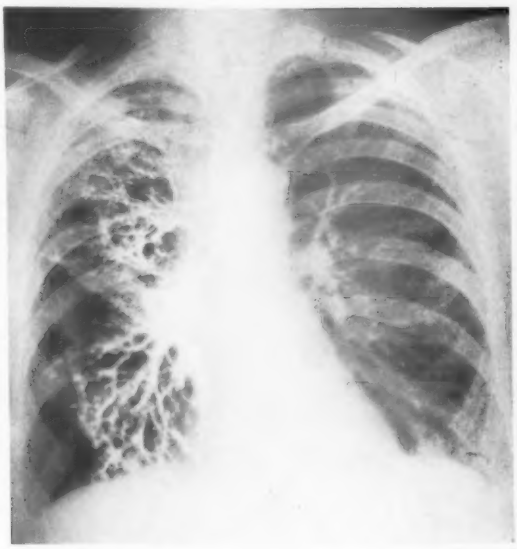

Fig. 12. Group 2. Case III. Bronchogram.

upper pole of the hilus to the axilla limited by pleural fissure crossing the second interspace. This infiltration leads to an annular shadow presenting a dense wall and a clear-cut inner border. Bronchogram shows a fluid level within this annular shadow and so disproves impression from the plain plate that the ring is due to a localized pneumothorax (Figs. 9 and 10).

Case III (No. 8308). M. P., female, aged forty-three. Duration of illness five years. Sputum positive before induction of pneumothorax, negative now after fifteen months of collapse.

Symptoms. Slight productive cough.

Roentgen Findings. Left lung, clear; right lung, partial pneumothorax confined to right lower lobe, entire upper and middle lobe re-expanded and in the extreme apex there are

Fig. 13. Group 3. Case I. Plain roentgenogram.

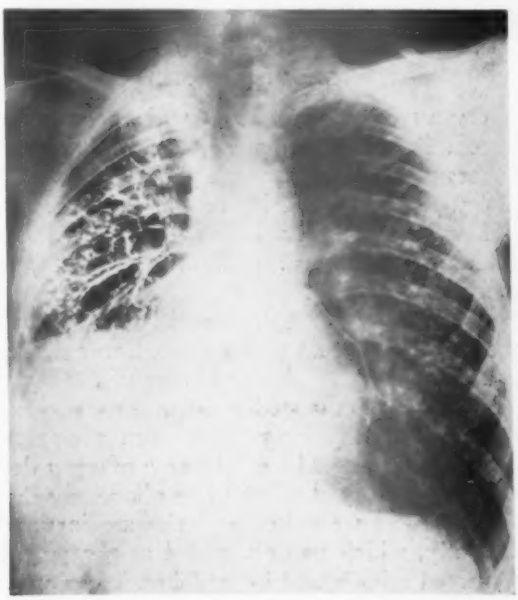

Fig. 14. Group 3. Case I. Bronchogram.

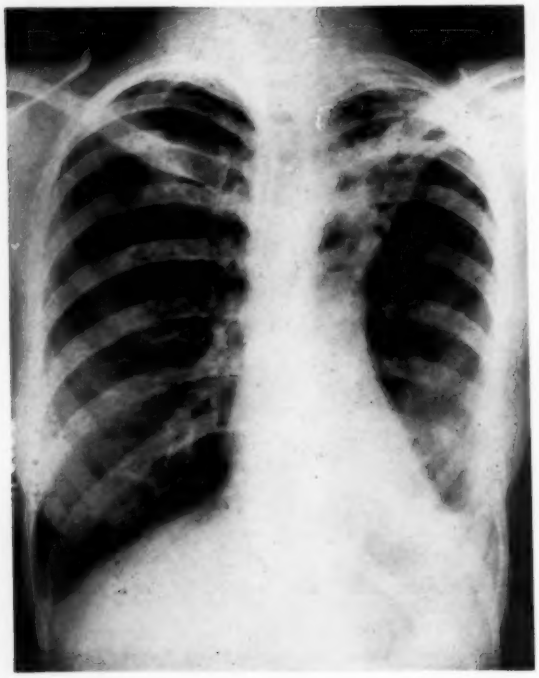

Fig. 15. Group 3. Case II. Plain roentgenogram.

multilocular areas of rarefaction. These were suspected to be small cavities which were the basis of the productive cough. Bronchogram outlines lung field which just falls short of these rarefied areas, thus leading to the belief that they are due to small pneumothoraces (Figs. 11 and 12).

GROUP 3 CASES

Case I (No. 8580). B. S., male, aged thirty-seven. Occupation: stone grinder. Duration of illness three years. Sputum positive.

Symptoms. Productive cough, dyspnea.

Roentgen Findings. Diffuse, bilateral, dense, nodular infiltration typical of tertiary stage of silicosis. The right diaphragm is elevated and above it there is a third degree density which merges at the axilla with a dense linear shadow coursing along the lower border of the eighth posterior rib to the mediastinum. Bronchogram reveals that the lung tissue seen above the dense line is upper lobe. The area of lesser density outlined by the dense line above, the density at the base below and the mediastinum medially, which was diagnosed as a cavity, is retracted middle and lower lobes. The density above the diaphragm is shown to be a mass of dilated divisions of the middle and lower lobe bronchi (Figs. 13 and 14).

Case II (No. 8216). M. H., female, aged twenty-two. Duration of illness three years. Sputum positive.

Symptoms. Productive cough.

Roentgen Findings. Fibrocavernous lesion of the left upper lobe. Extending from the floor of this cavity is a dense triangular shadow with one side formed by the floor of the cavity, the other by the left border of the spine and the base by a clearly defined line extending from the mediastinum along the upper border of the second rib to the outer border of the cavity. Within this dense shadow are numerous small areas of rarefaction. The bronchogram clearly shows this to be the upper lobe. Note, too, that the small areas of rarefaction are due to bronchiectasis (Figs. 15 and 16).

GROUP 4 CASES

Case I (No. 8574). W. G., male, aged twenty. Duration of illness one year. Sputum negative, positive on admission.

Symptoms. Productive cough.

Roentgen Findings. Entire lung field replaced by diffuse density. Bronchogram reveals a thickened pleura with a moderately reduced lung volume (Figs. 17 and 18).

Case II (No. 8561). R. S., female, aged thirty-seven. Duration of illness ten years. Sputum negative, positive on admission.

Symptoms. Productive cough.

Roentgen Findings. Plain plate (Fig. 19) re-

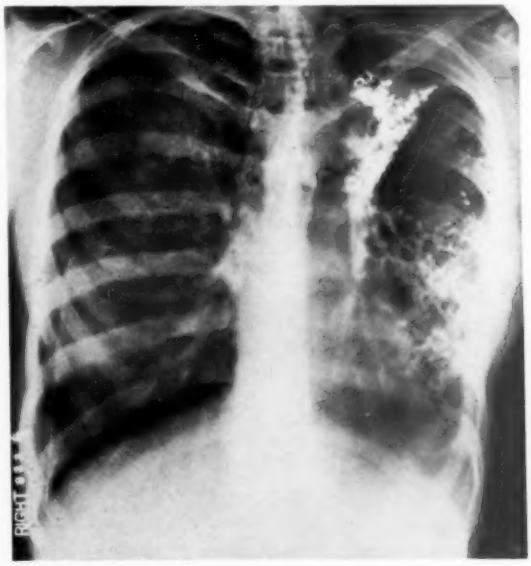

Fig. 16. Group 3. Case II. Bronchogram.

Fig. 17. Group 4. Case I. Plain roentgenogram.

veals diffuse density obscuring the entire right lung field. Trachea is markedly deviated to the right. Roentgenograms made with the Potter-Bucky diaphragm (Fig. 20) does not assist except to make the picture more confusing by the numerous moth-eaten areas brought out.

Fig. 19. Group 4. Case II. Plain roentgenogram.

Fig. 18. Group 4. Case I. Bronchogram.

Bronchogram (Fig. 21), however, clearly shows these moth-eaten areas to be due to marked bronchiectasis. Note also the esophagus.

Case III (No. 8405). M. W., female, aged twenty. Duration of illness two years. Sputum negative, positive on admission.

Fig. 20. Group 4. Case II. Roentgenogram made with Potter-Bucky diaphragm.

Fig. 21. Group 4. Case II. Bronchogram.

Fig. 22. Group 4. Case III. Plain roentgenogram.

Symptoms. Productive cough.

Roentgen Findings. Hydropneumothorax left side with horizontal fluid level terminating at the second anterior rib. The lung is shown to be almost completely collapsed. The shadows in question are the rarefied areas within the lung parenchyma above the second anterior rib. Bronchogram clearly shows the collapsed lung. Note horizontal lipiodol level in first interspace where physical signs of cavity were obtained. Diagnosis of cavitation was thus made certain and symptoms explained (Figs. 22 and 23).

Case IV (No. 8564). F. G., female, aged twenty-two. Duration of illness three years. Sputum positive.

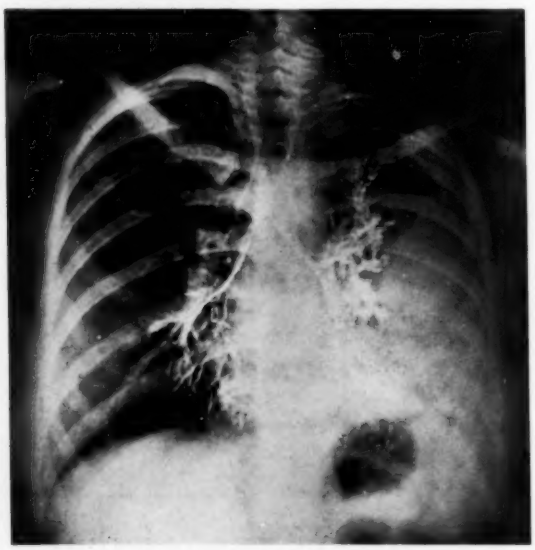

Fig. 23. Group 4. Case III. Bronchogram.

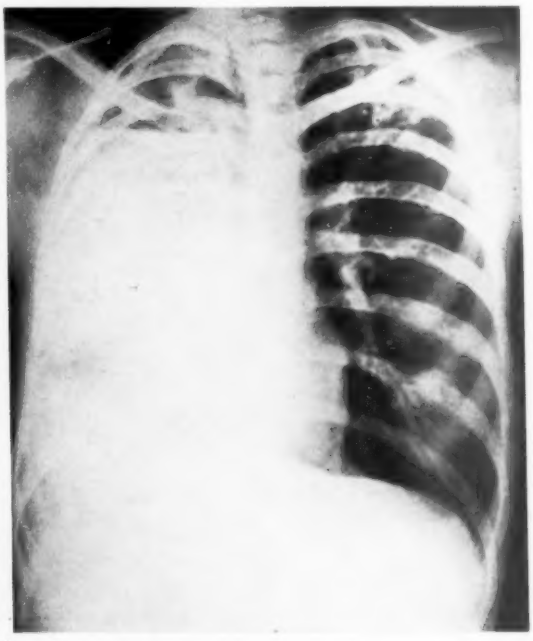

Fig. 24. Group 4. Case IV. Plain roentgenogram.

Fig. 25. Group 4. Case IV. Roentgenogram taken with Potter-Bucky diaphragm.

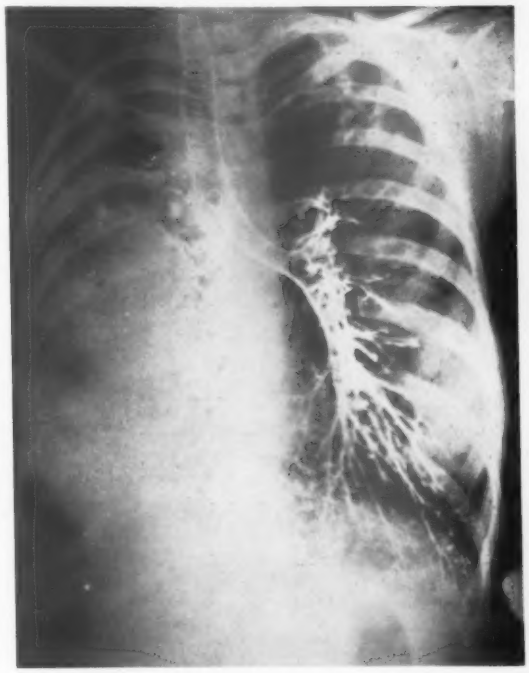

Fig. 26. Group 4. Case IV. Bronchogram.

Symptoms. Productive cough.

Roentgen Findings. Plain plate (Fig. 24) shows a hydropneumothorax with the entire right lung field obscured by diffuse density due to the fluid which terminates at the level of the clavicle. Potter-Bucky roentgenogram (Fig. 25) indefinitely outlines lung tissue but leaves one in doubt as to the meaning of the large annular shadow immediately beneath and below the clavicle. Bronchogram (Fig. 26) clearly shows limits of lung tissue and outlines division of the upper lobe bronchus leading to the annular shadow beneath and below the clavicle which

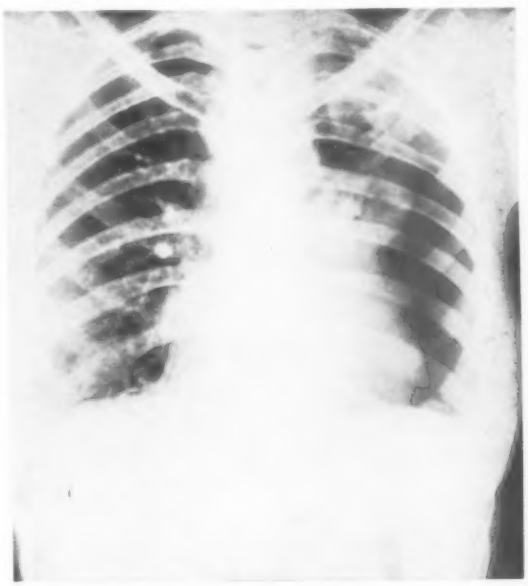

Fig. 27. Group 5. Case I. Plain roentgenogram.

Fig. 28. Group 5. Case I. Bronchogram.

is interpreted to be a cavity. This explains source of positive sputum.

GROUP 5 CASES

CASE 1 (No. 8596). G. S., female, aged nineteen. Duration of illness three years. Sputum positive.

Symptoms. Productive cough.

Roentgen Findings. Plain film shows a partial pneumothorax confined to the left lower lobe. The left upper lobe is unaffected. Large cavity occupying the apex. The partly collapsed left lower lobe shows no linear markings and is represented by a diffuse density. Bronchogram shows the entire lower lobe bronchus and its divisions heaped up into a knot; and so, on the basis of atelectasis, explains the diffuse density (Figs. 27 and 28).

I am indebted to Dr. B. S. Pollak, Medical Director, for his cooperation and to Dr. J. Pagliughi for the invaluable technical aid which made possible this report.

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ROUND FOCI TYPE OF PULMONARY TUBERCULOSIS*

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MY INTEREST in the round foci type of tuberculosis was aroused by the following case:

H.L.D., aged thirty-two, single, female, was referred to me for roentgen examination of the chest on December 30, 1931, by Dr. J. W. Cutler, to whom I am indebted for the privilege of reporting this case. Her history dates back to 1928 when she began to cough. In order to relieve this cough, a tonsillectomy was performed in March, 1929, but no improvement occurred. For three months previous to the present examination she complained of distinct hoarseness and pain on swallowing. Hemoptysis, small in amount, occurred one year ago and none since. There have been no pleural pains, no night sweats, no undue tiredness, but a moderate loss of weight.

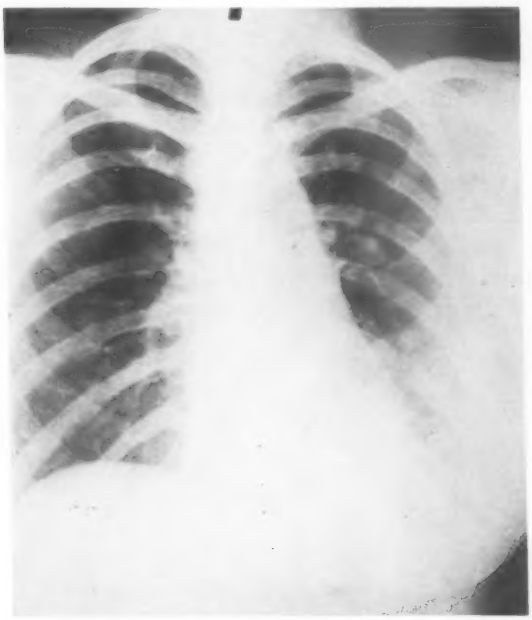

FIG. 1. December 30, 1931. Note sharply circumscribed shadows in both lungs.

Roentgen examination was made by me on December 30, 1931 (Fig. 1). It showed a few sharply circumscribed shadows in the upper lobe of the right lung, one in the middle lobe of the right lung, and one in the region of the left root. These presented a distinct appearance suggesting a secondary malignancy. The patient brought with her a film taken about one year before (Fig. 2) which showed the presence of the shadows in the right lung but two small shadows in the left lower lobe were present at that time which had apparently disappeared spontaneously. There was seen, however, on this film a very faint infiltration in the first interspace anteriorly. In view of the spontaneous disappearance of the lesion in the left lower lobe and the duration of one year between the original examination and the one made by me, I felt that the condition was not a clear cut case of secondary malignancy. The sputum was examined and found positive for tubercle bacilli. The patient was referred to a laryngolo-

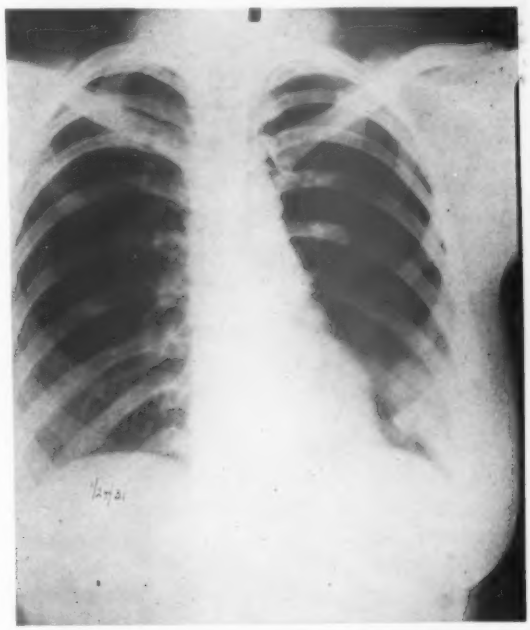

FIG. 2. January 24, 1931. Note presence of shadows in left lower lobe, not present at subsequent examinations.

* From the Roentgenologic Department, Jewish Hospital. Read at the Eastern Radiological Conference, Philadelphia, January, 1933.

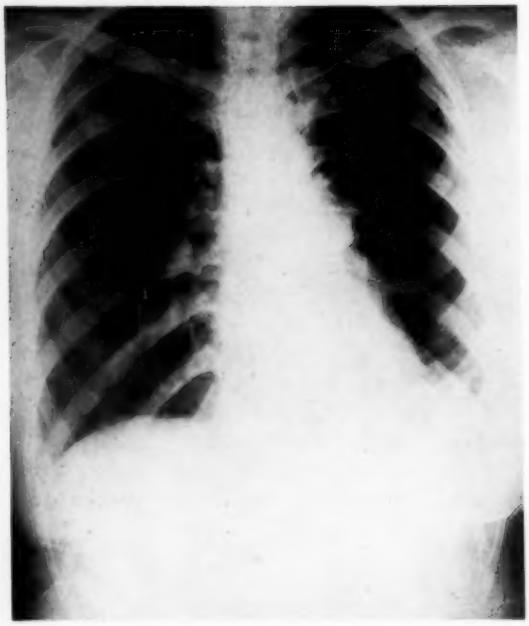

Fig. 3. June 23, 1932. Note artificial pneumothorax on left side, scattered deposits throughout right lung.

gist for examination of the throat for the hoarseness which seemed to be her greatest complaint. He reported that there was an inflammatory mass attached to the edge of the right vocal cord which was removed for histological examination and a clinical diagnosis of inflammatory neoplasm of the right vocal cord was made. The histological section subsequently showed that the tissue removed was tuberculous, although the gross appearances were not typical of a tuberculous lesion. Roentgen examination of the lungs made at the time of the biopsy by another roentgenologist showed that there were numerous circular deposits throughout both lungs which from the roentgen point of view represent metastatic nodules rather than tuberculous deposits. In view of these findings and with the idea in mind that there might be an associated tuberculosis with a secondary malignancy, a thorough study was made of the gastrointestinal tract and a thorough clinical examination of the entire body without any trace of a primary malignancy being found. It was therefore decided that this patient had a bilateral pulmonary tuberculosis manifesting itself by these deposits throughout both lungs which had all the characteristics and appearances of a secondary malignancy. The diagnosis of tuberculosis was further strengthened by the faint infiltration seen in the first interspace anteriorly at the initial roentgen examination which, by the time the patient came to us, had completely disappeared, and by her repeatedly positive sputum examinations. Treatment was then instituted by the production of an artificial pneumothorax on the left side which clinically showed more activity. Six months later, another roentgen examination was made (Fig. 3). At that time the entire left lung was almost completely compressed and the pathology obliterated by this compression. The right lung, however, showed few deposits throughout. Approximately two years after the original examination, another roentgen examination of the chest was made (Fig. 4). It showed fluid at the left base with an artificial pneumothorax of the left side. The lesions in the right lung persisted and one of these deposits showed distinct evidence of excavation. At no time was any roentgen therapy given. The sedimentation test showed moderate activity on December 30, 1931 (Fig. 5), and at the last examination showed a marked drop indicating marked activity of the tuberculous process (Fig. 6).

In view of this unusual appearance, I looked through the literature to obtain

Fig. 4. November 26, 1932. Note fluid and air in left pleural cavity. Note excavation of focus in right upper lobe.

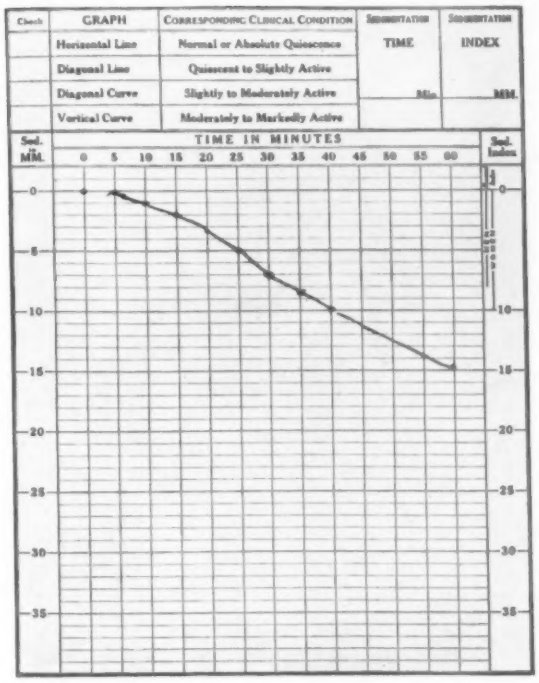

Fig. 5. Sedimentation test, December, 1931, indicating moderate activity.

some idea of how often tuberculosis manifests itself in the form of these round foci, so closely resembling secondary malignant deposits. I could find no reference at all to this type of tuberculosis in the American literature. I found that about 6 to 8 isolated cases have been reported in the German literature. A very comprehensive article analyzing all cases reported up to that time was written by Straub[1] of Germany in 1932. He analyses 10 cases of his own which he has seen in his clinic besides those reported in the literature. This form of tuberculosis occurs either as round foci in a chest which has other definite and characteristic tuberculous lesions or they are the only lesions depicting the disease. The larger number of cases have additional roentgen evidence of tuberculosis. The case reported here belongs to the much smaller class in which there is practically no other evidence indicating tuberculosis. These lesions can be detected only by the roentgen ray. There is no method, Straub states, by which this form of tuberculosis can be diagnosed by symptoms or physical signs. The lesions are usually quiescent, many times produce no symptoms and are often detected accidentally during the course of other roentgen studies or at post-mortem examination. In the majority of the cases, studied roentgenographically over a few years, the lesions have not undergone any change. Of all cases reported and cited by Straub, there is none reported in which the spontaneous disappearance of some of the foci have occurred, as in the case cited here. This may have been due to the fact that there was no opportunity of observing them so early or so continuously as has been my good fortune in this case.

Clinically, most of these cases are afebrile, have no constitutional reactions or symptoms and feel no discomfort. When these foci occur in addition to other tuberculous lesions in the lung, they remain quiescent and undergo very little, if any, change no matter how active and progres-

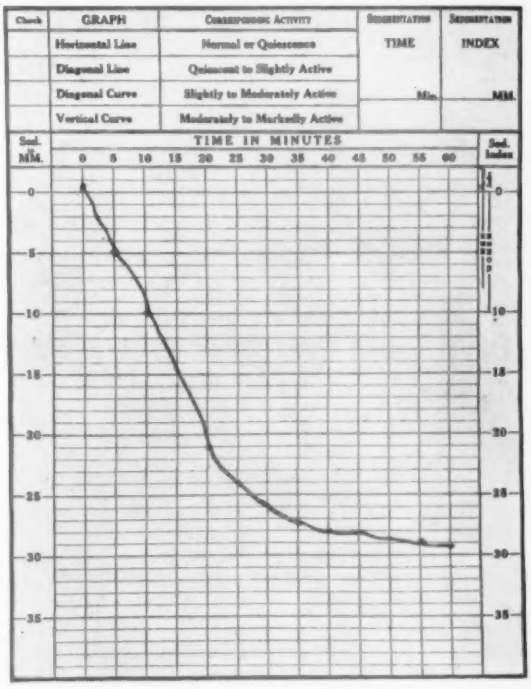

Fig. 6. Sedimentation test, December, 1932, indicating marked activity.

[1] Straub, H. Die tuberkulösen Rundherde der Lungen. *Ztschr. f. klin. Med.*, 1932, *121*, 515–532.

sive the other lesions may be. In other words, of themselves, they play no part in the production of symptoms. A small minority of these cases, however, present distinct evidence of activity. There are fever, cough, positive sputum, and usually one attack of slight hemoptysis, as reported in this case. Where the lesions are active, these foci may enlarge but still maintain their coin-like appearance and do not become the diffuse active tuberculous lesions usually seen. Once the lesions appear in this form, they remain so. A few cases have been reported in which one or more of these foci have undergone excavation, as in this case. The number of foci present varies. The majority of the cases have one solitary focus, but in these there is usually evidence of other tuberculous lesions. Some have more; one case reported had fourteen foci.

Pathologically, in those cases which came to necropsy, these lesions appeared as rounded parenchymatous consolidations surrounded by a capsule of fibrous tissue without any surrounding tissue reaction. Because of this fibrous capsule most of the lesions are more or less dormant and quiescent.

Of the 10 cases reported by Straub himself only a few were purely the round foci type.

Some of the observers have believed that these foci represent the earliest possible tuberculous infiltration and that they are analogous to and take the place of the primary lesion as we know it. But the primary lesion is practically always accompanied by glandular involvement, whereas in this form of tuberculosis there is practically no adenopathy, as is seen in the illustrations. Again, if these foci were really primary lesions, they should occur much more often in roentgen films of the chest than we find them. Although Straub calls these lesions rare, I believe that if we kept them in mind we would find such coin-like foci more often in our roentgenograms. Since my attention was directed to this form of tuberculosis, I have, I think, found two more cases which I am now studying.

Where the foci occur in conjunction with other lesions roentgenologically indicative of tuberculosis their interpretation is not so difficult, although we must keep in mind that secondary malignancy and tuberculosis may occur, though very rarely, in the same chest. But when the entire picture is one of isolated foci, as in this case, then a differential diagnosis between these lesions and secondary malignancy is hard to make, particularly when we remember that in some cases of secondary malignancy of the lung proved by post-mortem and microscopic studies, even autopsy has failed to find the primary lesion. Of course, if given the opportunity to study a case for two years as we have done and watch the evolution and change of the lesions, one could easily eliminate secondary malignancy.

In conclusion, I wish to say that I believe if we keep in mind the fact that tuberculosis may occur in the round foci form, it may help us to properly evaluate the roentgen findings in cases which closely resemble secondary malignancy and in which no primary lesion can be found.

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THE INVERSE RATIO IN THE ROENTGEN VISUALIZATION OF THE BRONCHI AND ALVEOLI AFTER THE INJECTION OF CONTRAST MEDIA*

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THE USE of radiopaque substances in lung roentgenography is by far the best method that has yet been devised for obtaining accurate information relative to the morphology, location, and extent of bronchial dilatation. Many clinical investigators have successfully applied these iodized oils in their research work on the respiratory physiology and pathologic physiology of the bronchi in the living.[1,8,10] We have been engaged in the study of the possible relationship between the etiologic factors and the polymorphic manifestations of bronchiectasis as outlined by iodized oil, and the results are discussed in a separate communication.[2] This article is intended to deal only with the relation of the alveolar and bronchial elements as visualized on the roentgenogram after the intratracheal introduction of radiopaque substances such as lipiodol, skiagenol, etc. (we have used mostly lipiodol). This relation of the injected bronchi and alveoli is of diagnostic value in early bronchial affections, both functional and anatomical.

We were impressed by the fact that in those cases in which the alveoli were outlined, the bronchi were scarcely visible, whereas in the cases in which the bronchi appeared visible, the alveoli were only slightly delineated or altogether absent. In other words, the roentgen visualization of the injected bronchi and alveoli seemed to be inversely proportional—the more abundant the alveoli appeared, the less noticeable were the bronchi, and the more conspicuous the bronchi loomed, dilated and filled with lipiodol, the less numerous were the alveoli. This inverse ratio in the visibility of the bronchi and the alveoli is graphically illustrated in Figures 1*a* and 1*b*.

Figure 1*a* is a roentgenogram of a case

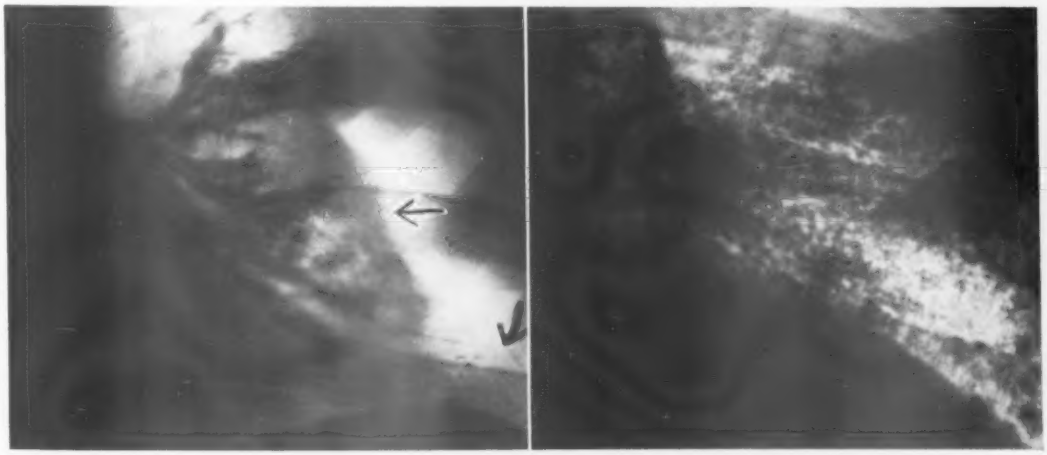


FIG. 1*a*. Roentgenogram of a case of left pneumothorax after injection of 20 c.c. of lipiodol; the lipiodolized bronchi stand out prominently, but none of the collapsed alveoli are outlined.

FIG. 1*b*. Roentgenogram of a normal lung after injection of 20 c.c. of lipiodol; the iodized alveoli are well outlined, forming a thick "leafage" which conceals all the bronchi.

* From the Medical Department of the Cumberland Hospital, Dr. Henry Wolfer, Chief of Service.

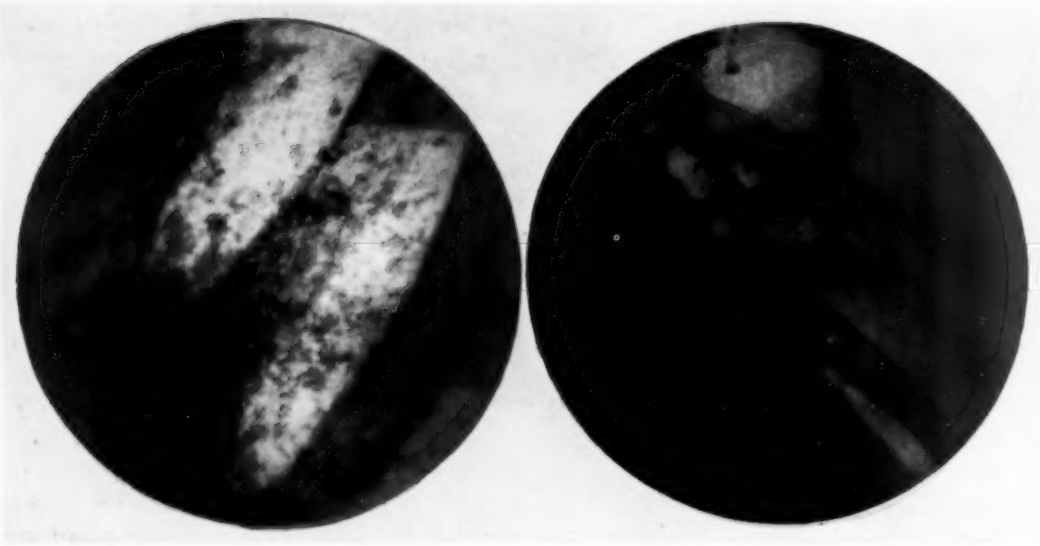


Fig. 2. Roentgenogram of a normal lung after injection of skiagenol; the iodized alveoli form a delicate pattern of a dotted veil through which bronchi are scarcely visible.

Fig. 3. Roentgenogram of a case of multiple cylindrical dilatation; the lipiodolized bronchi appear like the branches of a dead tree bluntly chopped off, showing no alveolar leafage.

of left artificial pneumothorax taken after the injection of lipiodol into the left lower lobe; all the lipiodolized bronchi stand out prominently like solid cylindrical tubes, but very few alveoli can be traced, since they had all previously been compressed by the pneumothorax. Figure 1*b* is a roentgenogram of a normal lung taken after the injection of 20 c.c. of lipiodol into the right lower lobe; the alveoli are well outlined, forming a delicately dotted veil which seems to cover all the bronchi. Figure 2 shows the normal alveoli after injection of skiagenol forming a more delicate pattern of finer dots in the lacework, with but a faint suggestion of the bronchial outline.

Bonnamour and his coworkers[3,4] adequately describe the roentgenographic image of the lipiodolized alveoli of the normal lung as "exactly resembling the foliage of a tree in full season under which the branches are almost entirely concealed" (Fig. 1*b*). The contrary holds true when the bronchi are diseased: the injected lipiodol barely penetrates into the alveoli so that no foliage is visible, but the bronchi filled with lipiodol look like the dry branches of a tree in winter (see Fig. 3).

Under what conditions do the bronchi appear outlined with lipiodol without their corresponding alveoli? Generally speaking, we may say that the two main conditions, irrespective of the causative agents, are: (*a*) apneumotosis of the alveoli, such as in atelectasis, compressive pneumothorax, etc.; (*b*) loss of expulsive power of the bronchi due to inflammatory, degenerative, or sclerotic changes of the bronchial wall. These changes in the bronchi may or may not terminate in bronchiectasis, but will always cause a disturbance in the function of the bronchi, which can be studied by means of bronchography after the injection of lipiodol long before any clinical symptoms have appeared.

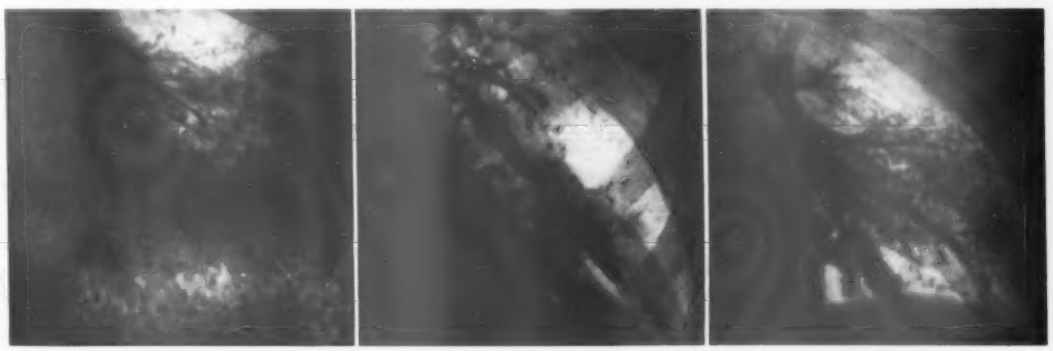
The aim of injecting contrast media into the air passages is not only to elicit the gross pathologic changes in the caliber of the bronchi but also to determine the functional capacity and expulsive force of the bronchial wall. We must keep in mind that the bronchi are not merely rigid pipes conducting the air to and from the alveoli, but are flexible and dynamic in nature, actively changing their caliber with inflation and deflation of the lung. These re-

spiratory variations in caliber of the physiologically functioning bronchi have been studied roentgenologically and bronchoscopically by Heinbecker,[5] Jackson,[6] and others.

Besides their rhythmic respiratory motion, the bronchi also exhibit expulsive and protective movements. This expulsive mechanism consists of (*a*) the action of the cilia which line the bronchial tract as far down as the finer bronchioles, (*b*) the cough reflex which is present mostly in the upper airway, the second and first order of the bronchi, and the trachea, (*c*) peristaltoid movement, a progressive wave-like motion resembling peristalsis, as far down as the airway terminal. Reinberg describes this peristaltic movement of the bronchi and finds it increased in certain pulmonary diseases and decreased in pathologic conditions which involve the smooth muscles of the bronchi. Macklin[7] discusses in detail the dynamic function of the bronchi, and quotes many investigators who claim that the expulsive movement depends also upon the integrity of the bronchial mucosa and presumably upon the sensory nerve endings found there; hence it will be attenuated or altogether absent when the mucosa is diseased or destroyed.

It is obvious that the bronchi are equipped with an efficient expulsive mechanism which controls the evacuation of the respiratory tract. When the bronchi are intact they expel the lipiodol like any other foreign body, either outward through the trachea, or propel it towards the periphery into the alveoli. Normally functioning bronchi rid themselves of the lipiodol in about fifteen minutes, and all the bronchi which remain filled with lipiodol at the end of that period are to be considered as retentive bronchi, the walls of which are either anatomically involved or physiologically insufficient. Consequently the more diseased a bronchus is, the more lipiodol it will retain, and the less the alveoli of its corresponding territory will be visible on the roentgenogram. This localized disappearance of alveolar leafage is of diagnostic significance and deserves further study.

Pathologic conditions involving any of the layers of the bronchial wall cause a diminution in the functional capacity of the bronchi which evidences itself by the retention of the lipiodol in the bronchial tubes, though no actual ectasia has yet occurred. In cases of acute bronchitis in which the mucosa is involved, the lipiodolized bronchi often appear like hollow tubes, or, as Rosenthal[9] calls them, "macaroni tubes," i.e., only the walls appear outlined, but the



4*a* 4*b* 4*c*

Fig. 4*a*. A case of tubular dilatation. Note the walls of the bronchi lined with lipiodol and their free lumen, resembling "macaroni tubes." The rest of the alveolar leafage appears well outlined.

Fig. 4*b*. A case of dominantly saccular bronchiectasis, the cavities of which appear well filled with lipiodol. Note absence of alveolar foliage.

Fig. 4*c*. A case of cylindrical bronchiectasis of various degrees. Note the dilated "leafless" bronchi below, and the "foliated" branches above.

lumen is empty. In such cases, the corresponding alveoli may be visible though not as abundant as in normal cases (see Fig. 4*a*). These bronchi have preserved their normal form, narrowing in caliber from the inner toward the outer or peripheral zone. In cylindrical bronchiectasis, the bronchi filled with lipiodol appear like solid bars with very little corresponding alveolar foliage, and sometimes the lipiodolized bronchi assume the aspect of dried branches bluntly chopped off at their ends (Fig. 3).

The more diseased and dilated the bronchi are, the more lipiodol they will retain, and only a small overflow will penetrate into isolated alveolar areas. Figure 4*b* is a roentgenogram of a case of marked saccular dilatation of the right lower lobe which was injected with 20 c.c. of lipiodol. It shows two saccular bronchiectatic cavities containing almost all of the injected material, allowing only a few interrupted twigs and an occasional alveolar cluster to be outlined. However, in cases of localized cylindrical dilatation the lipiodol will delineate only the dilated bronchi as leafless branches, whereas the rest of the same lobe will reveal more leaves than branches, as illustrated in Figure 4*c*.

This inverse ratio in the bronchial and alveolar visualization is of diagnostic significance, particularly in early cases of tubular or cylindrical dilatation, provided the proper technique is adhered to, both as to the amount of lipiodol injected and the time of roentgen-ray exposure after the lipiodol has been introduced. The French clinicians introduce 30 c.c. for the outline of one lobe, but we find that 20 c.c. is sufficient, and all our roentgenograms represent the image of the same quantity of lipiodol. The roentgenogram should be taken about fifteen minutes after the injection. If the patient coughed severely before the roentgen exposure, the alveoli will appear blurred and blotchy, and are not to be taken as a diagnostic criterion. However, it is not difficult to train the patient to suppress his cough until the roentgenograms have been taken.

The method of injection of the iodized oil, whether through the transglottic, the supraglottic, or the transcricothyroid route, has little effect on the image obtained, as long as the same quantity is introduced. We find the supraglottic method the most convenient, and we outline only one lobe at a time in order to have a definite standard of comparison.

SUMMARY

When iodized oil is injected intratracheally, it tends to delineate the bronchi and alveoli in an inverse proportion, i.e., the more the alveoli are outlined, the less the bronchi are visible, and vice versa. This inverse ratio in the visibility of the iodized bronchi and alveoli is of diagnostic significance. In a normal lung the outlined alveolar element predominates, overshadowing all the bronchi, and the roentgenographic image simulates a tree in midsummer when the abundant leafage covers all its branches. Diseased and dilated bronchi retain most of the injected material, and only very few, if any, of the alveoli in the corresponding territory will be delineated on the roentgenogram. In cases of extreme cylindrical dilatation, the filled bronchi resemble the branches of a tree in winter with no remnant of the former foliage. The absence of the alveolar leaves may be general or localized, depending on the extent of the bronchial dilatations. Any bronchus which retains the lipiodol fifteen minutes after its injection is to be considered functionally impaired, irrespective of its morphologic appearance.

In order to maintain definite standards of comparison, it is advisable always to inject 20 c.c. of the lipiodol, and to outline only one lobe at a time.

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THE BRONCHOPULMONARY SEGMENT WITH SPECIAL REFERENCE TO PUTRID LUNG ABSCESS*

ANATOMIC AND ROENTGENOGRAPHIC ASPECTS

By AMEIL GLASS, M.D.
NEW YORK CITY

CLINICAL, operative, and autopsy studies at Mount Sinai Hospital have demonstrated that putrid lung abscess in its primary evolution involves definite and circumscribed regions of the lung.

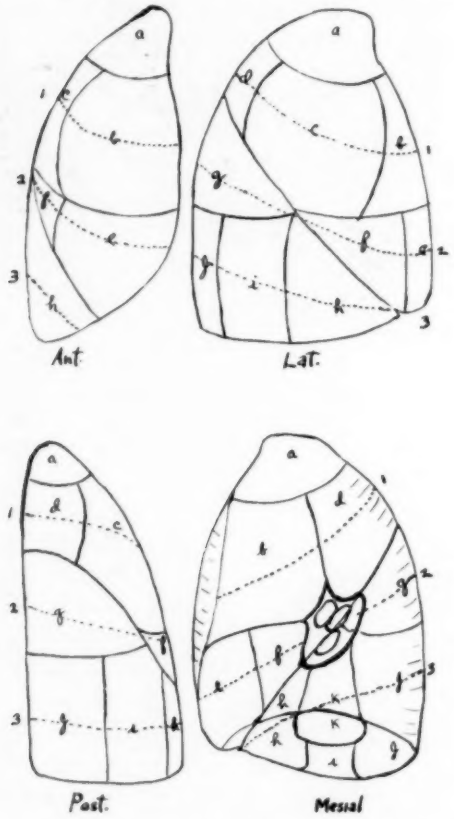

FIG. 1. Right lung, four views, showing bronchopulmonary segments. *a*—upper lobe apical segment; *b*—upper lobe anterior segment; *c*—upper lobe axillary segment; *d*—upper lobe paravertebral segment; *e*—middle lobe anterior segment; *f*—middle lobe axillary segment; *g*—lower lobe apical segment; *h*—lower lobe anterolateral segment; *i*—lower lobe posterolateral segment; *j*—lower lobe paravertebral segment; *k*—lower lobe mesial segment (cardiac lobe). Dotted lines 1, 2 and 3 represent level of cross sections shown in Figure 2.

These regions are subdivisions of pulmonary lobes and, as we have shown,[1] possess constantly a definite shape, size and position in the thoracic cavity. Each region, which we have designated a bronchopulmonary segment, is composed of a bronchus and its associated alveolar tissue. The bronchus is one of the main divisions of a lobar branch and each segment is a potential area of aspiration infection because of the fact that its bronchial orifice has a prominent position in the main bronchial tree. Figures 1 and 2 show the outlines of the segments on the lung surface and cross sections at different levels.

A knowledge of the bronchopulmonary segments with their bronchi is of aid to the roentgenologist from the standpoint of localization of roentgen shadows. With the operative procedures for lung abscess, especially the one-stage operation, being employed more frequently, accurate localization of such lesions has become increasingly important. While the expert roentgenologist can, by means of meticulous roentgenographic and roentgenoscopic examination, accurately localize most lesions, a knowledge of the bronchopulmonary segments not only makes these localizations much simpler, but also makes it possible in some instances to determine the exact site of a lesion when the roentgenogram and roentgenoscope fail. This practical importance of the bronchopulmonary segment is based upon the fact that lung abscess is anatomically rigidly related to the bronchi and seg-

[1] Kramer, R., and Glass, A. Bronchoscopic localization of lung abscess. *Ann. Otol., Rhin. & Laryng.*, 1932, *41*, 1210–1220.

* From the Services of Dr. H. Neuhof and Dr. H. Wessler and the Radiological Department (Dr. L. Jaches, Director) of the Mt. Sinai Hospital, New York.

ments. The bronchopulmonary segment is the unit of localization in lung abscess.

In the following discussion the term "lung abscess" is restricted to a circumscribed, discrete lesion and not a widespread, diffuse suppuration. It does not include small cortical abscesses or small localized empyemata which simulate a lung abscess on the roentgenogram.

The diagrams included here indicate the positions of the segments of the right lung. The segments are practically the same in the left lung. Each segment is named according to its position in the thoracic cage and pulmonary architecture. The corresponding bronchi, which are readily visualized by the bronchoscope, have the same nomenclature. The dotted lines in Figure 1 indicate the levels of the cross sections shown in Figure 2.

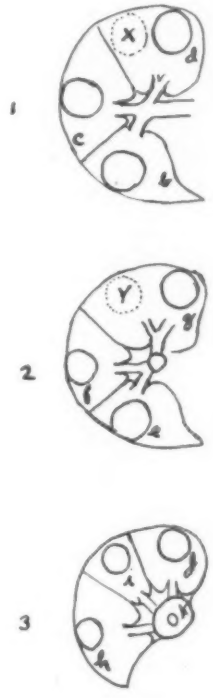

Fig. 2

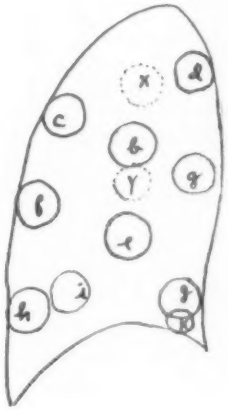

Fig. 3

Fig. 2. Cross sections of right lung at levels indicated in Figure 1. Circles represent abscess cavities as related to segments. Dotted circle shows occasional variations of position in posterior segments.

Fig. 3. Projection of cavities forward as in posteroanterior roentgenogram; inner field shadows (*d*, *g*, *j*) are always in posterior segments with one rare exception (*k*). Cross sections of Figure 2 show why this must be so. Lateral field shadows (*b*, *e*, *x*, *y*) are in anterior or posterior segments. A lateral roentgenogram is necessary to decide which it is.

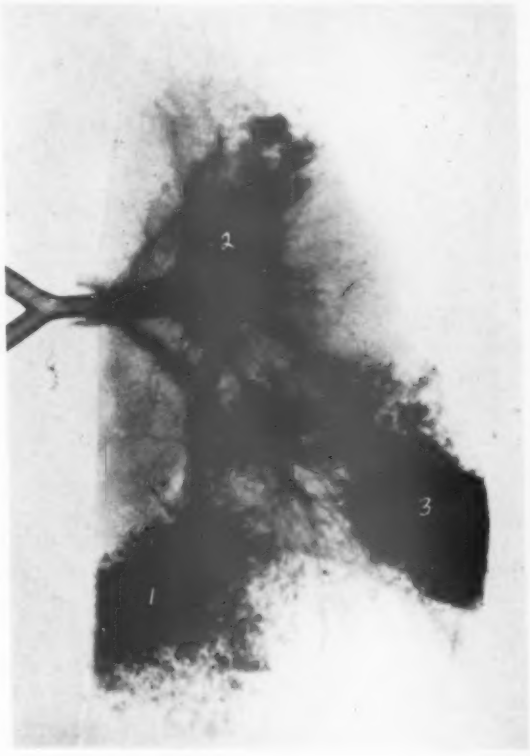

Fig. 4.

Figure 2 shows the cross sections of the right lung at three levels so as to include all the segments except the apical. The directions which the bronchi take in each segment are also indicated. The position taken by a lung abscess cavity as determined from a series of post-mortem specimens and operated cases is shown in each segment. The dotted circles indicate the occasional different position assumed by the cavities in the two posterior segments. In each case the main cavity approaches that surface of the segment towards which the main bronchus points.

If these cavities are projected forward to an anteroposterior view of the lung, as in a roentgenogram, they will appear as indicated in Figure 3. It must be stated at this point that the representations of the ab-

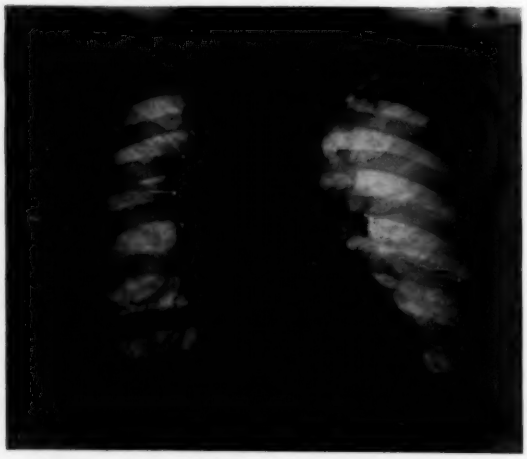

Fig. 5.

scesses are diagrammatic and usually not so precisely limited and situated. They are so drawn in order to make the following explanations clearer.

It will be noted that all the inner field circles (*d*, *g*, *j*) lie in posterior segments adjacent to the spine. Only one (*k*) does not lie in a posterior segment. It lies in the mesial segment (cardiac lobe) and is always situated on the dome of the diaphragm adjacent to the heart.

All the outer field circles (*c*, *f*, *h*) lie in axillary segments and approach the surface in the axilla. The majority of middle field cavities (*e*, *b*) lie in anterior segments. Occasionally they lie in posterior segments (*x*, *y*). Cavities in the posterolateral segment usually lie in the position indicated (*i*) or in the middle lung field at a low level.

Fig. 6.

These diagrams indicate the positions taken by lung abscesses in the pulmonary segments, and the positions it is assumed they would take in an anteroposterior projection. In order to demonstrate the correctness of the assumption, the following procedure was carried out: Fresh human lungs were prepared so as to expose the bronchi without injury to the alveoli. These were kept constantly inflated and a thickened solution of sodium iodide injected into the the main bronchus of each segment. Roentgenograms were taken to show the positions

Fig. 6*a*.

of the shadows in anteroposterior and lateral views.

Figure 4 shows injection of three segments. Inner field shadow (1) represents injection of lower lobe paravertebral segment (*j*) in Figures 1, 2 and 3. Middle field shadow (2) represents injection of upper lobe anterior segment (*b*) in Figures 1, 2 and 3. Lateral field shadow (3) represents injection in anterolateral segment (*h*).

An analysis of numerous injected specimens corroborated the view previously stated, namely, that shadows in the inner lung field represent disease of the posterior

segments. Shadows in the lateral lung field represent disease of the axillary segments. Shadows in the middle field represent disease of either anterior or posterior segments and a lateral film is necessary to decide which it is.

The foregoing description of the pulmonary segments and positions assumed by abscesses within them may be applied clinically to the localization of lung abscess. The posteroanterior roentgenogram affords the clearest view of the lungs and always shows abscess shadows to the best advantage. Lateral views always have the obscuring spinal column, heart and shoulder

Fig. 7.

bones. The shadows on anteroposterior films can, in most instances, be assigned to one of the three vertical fields previously mentioned and thereby be located accurately in the corresponding segment of lung.

The following roentgenograms of cases of lung abscess show the typical location of shadows and the region of lung to which each corresponds.

Figure 5 shows a typical and very common inner field shadow bordering on the spine. It always represents an abscess in a posterior segment, at this level, the right lower lobe, apical segment (*g*) (Figs. 1, 2, 3).

Fig. 8.

Figure 6 represents an inner field shadow on the dome of the diaphragm. At this level, the only exception to the rule, an inner field shadow is not always in a posterior segment. In very rare instances it may be in the mesial segment (*k*) and is recognized as in this case by a lateral plate (Fig. 6*a*).

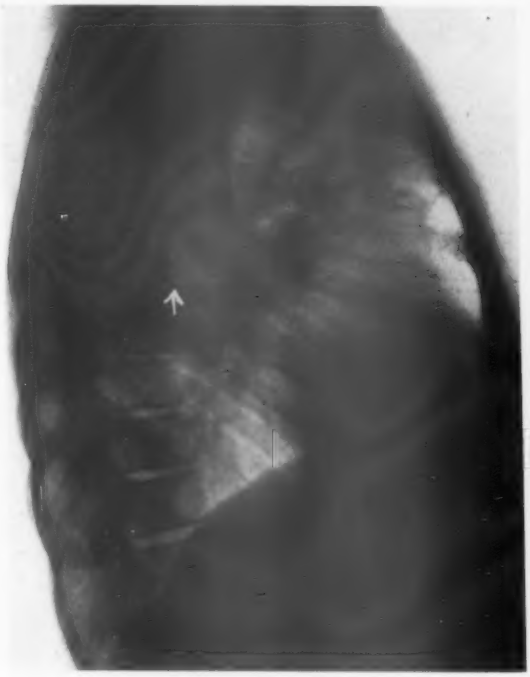

Fig. 9.

Figure 7 shows a typical lateral field shadow. It always represents an abscess in an axillary segment, at this level, the upper lobe axillary (*c*) in Figures 1, 2 and 3.

Figure 8 shows a middle field shadow usually representing an anterior segment abscess. A lateral plate is necessary to decide certainly. If in a lateral plate such a shadow lies posterior to the vertical midline of the profile view as in Figure 9, it lies in a posterior segment; if it lies anterior to this midline, it lies in an anterior segment. In neither case is it necessary for the shadow to extend to the periphery of a lateral view.

CONCLUSIONS

1. Lung abscess is confined to definite circumscribed regions of the lung, the bronchopulmonary segments.

2. The bronchopulmonary segments have a constant size, shape and position in the thoracic cavity.

3. The roentgenographic shadows of segmental diseases such as lung abscess have a position on the roentgenogram characteristic for each bronchopulmonary segment.

4. Studies of operated cases and postmortem material in conjunction with roentgenograms show that:

(*a*) On a posteroanterior roentgenogram, inner field abscess shadows represent abscesses in the posterior segment, lying nearest the posterior surface of the lung. One rare exception is noted.

(*b*) Lateral field shadows represent abscesses in axillary segments lying nearest the axillary surface of the lung.

(*c*) Middle field shadows represent abscesses in anterior segments or in posterior segments. A lateral film is required to determine the position in this group.

5. Roentgenograms of inflated lung specimens whose segments were injected with a thickened sodium iodide solution corroborate these observations.

Post-mortem material was made available through the kindness of Dr. Louis Gross, Director of Laboratories at the Mt. Sinai Hospital.

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SYPHILITIC GUMMA OF THE LUNG*

CASE REPORT

By EUGENE FREEDMAN, M.D., *and* CHARLES S. HIGLEY, M.D.
CLEVELAND, OHIO

WHILE many cases of syphilis of the lung diagnosed on the basis of clinical findings have been reported, the number of autopsied cases in the literature is not great. McIntyre[10] reviewing the literature found that there were only 48 cases reported between 1854 and 1920 which were verified by autopsy. We are reporting a case which was confirmed by post-mortem examination and which conforms to the diagnostic criteria necessary for the diagnosis of pulmonary syphilis as proposed by Howard.[7]

CASE REPORT

L.A., white housewife, aged thirty-six, was admitted to City Hospital on November 2, 1932, complaining of enlargement of the abdomen, swelling of legs, and jaundice. She had had frequent attacks of epilepsy for several years and six years previously during an attack was burned about the neck. A year ago she first noticed that her abdomen was larger than normal. Since then it had continued to enlarge and three weeks previous to admission it became quite hard. For the previous six weeks there had been increasing edema of the legs. She had noticed the jaundice for several months. She had a non-productive cough for about one month before admission, which was more noticeable when she was lying down. There was no loss of weight or abdominal pain or discomfort. Slight dyspnea was noticed a few days before admission. The past history was not significant with the exception of five miscarriages. Patient has four living children.

Physical examination revealed a well-developed, but poorly nourished white woman with icterus of the skin and conjunctivae. The pupils were equal and reacted to light and accommodation. The eyegrounds showed the marked bilateral black choroidal pigmentation, often found in luetic choroiditis. The left lung appeared normal. The right lung was dull to percussion at the base and many crepitant râles were heard over this area. There was a soft systolic murmur at the apex of the heart. Blood pressure 117/72. Spleen was firm, smooth and non-tender, and extended down to the level of the umbilicus. The liver was palpable two fingers below the costal margin (Fig. 1). There was no ascites. Rectal and pelvic examinations were negative. Reflexes were physiological.

FIG. 1. Photograph of patient showing marked enlargement of the spleen. The liver extends one finger's breadth below the costal margin.

Laboratory. Urine showed urobilin, otherwise normal. Red blood cells, 2,900,000; Hb, 50 per cent; white blood cells, 3,200–6,800. Blood smear was essentially normal. Blood platelets numbered 180,000 and the fragility test was normal. Icteric index was 25.4. Blood Wassermann reaction was four plus on two occasions and the spinal fluid Wassermann was negative.

* From the Departments of Roentgenology and Medicine, Cleveland City Hospital and Western Reserve University.

Gum mastic curve was flat. No tubercle bacilli were found in the sputum.

Course. The patient received potassium iodide minims 10, three times a day and was given 0.2 grams of thiobismol intramuscularly for 13 doses. Under this therapy the spleen decreased in size and hardness. The icteric index increased from 25 to 12 in seventeen days. The crepitant râles at the right base disappeared. The patient was allowed to get out of bed. On the forty-fourth hospital day she developed a nasopharyngitis and her temperature rose to 38° C. Four days later her temperature increased to 39.5° C. She became cyanotic. The respiratory rate increased to 40 per minute and a few râles could be heard throughout both lungs. She died on the fiftieth hospital day.

Fig. 2. Photograph of right lung with the lower lobe sectioned. The sharp demarcation of the gumma is well demonstrated.

Differential Diagnosis. Tuberculosis of the base of the right lung was ruled out by the absence of fever and tubercle bacilli in the sputum and the diminution in size of the lesion as shown by serial roentgenograms. Local and metastatic malignancy was ruled out by the relatively good general condition of the patient. The diagnosis of syphilis of the lung was made by elimination of the other possibilities, by the positive Wassermann reaction and syphilitic choroiditis and because the lesion was located in the common site of gumma of the lung.

Roentgenograms taken November 8, 1932, showed a dense cloudiness throughout the distal one-third of the right lung field. The upper border of this shadow was sharply defined. The heart and trachea were in the midline. The outlines of the right diaphragm were obliterated by this shadow. The lateral view showed an oval shadow of increased density in the apex of the right lower lobe, which was sharply circumscribed and extended from the hilus region downward. It measured about 8 cm. in length and 3 cm. in width. The region of the right middle lobe was cloudy. The appearance was thought to be due either to a primary lung tumor in the right middle lobe with a metastatic node to the right lower lobe or metastatic tumors in both the middle and lower lobes (Figs. 3 and 4).

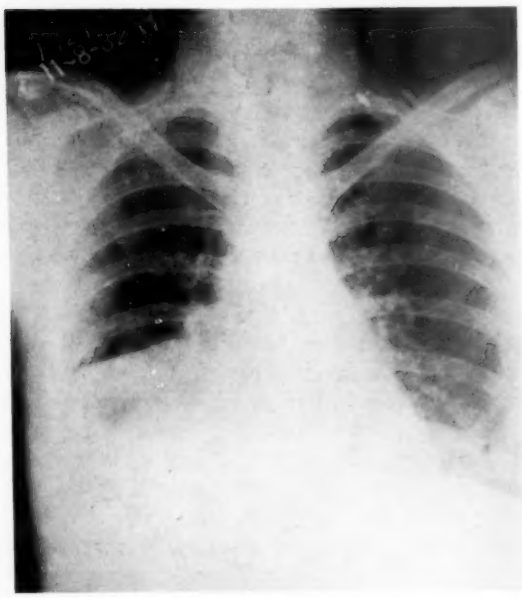

Fig. 3. Anteroposterior view of the chest showing a dense cloudiness throughout the distal one-third of the right lung field, produced by the gumma of the lower lobe and by the atelectasis of the right middle lobe.

Lipiodol was injected into the right main bronchus on December 21, 1932, and subsequent films showed no evidence of bronchial

obstruction. All the bronchi leading to the middle and lower lobes were of normal size and configuration. The anteroposterior view showed the cloudiness throughout the right base to have diminished, but the lateral view still showed the previous sharply circumscribed oval shadow, which did not appear to be smaller (Figs. 5 and 6).

This examination ruled out a pulmonary malignancy and confirmed the clinical diagnosis of syphilis of the lung. The decrease in the size of the cloudiness at the right base also appeared, after the specific therapy, to be a substantiating factor.

Pathology. We are indebted to Dr. H. T. Karsner and Dr. D. Seecof for their aid in the study of pathology of this case.

Fig. 4. Right lateral view showing the oval shadow of increased density in the apex of the right lower lobe, representing the gumma (arrows). There is also a cloudiness in the right middle lobe due to atelectasis.

The necropsy was performed two and a half hours after death by Dr. T. M. Wille and was restricted to the examination of the lungs, liver and spleen.

Externally, the important findings were cicatricial scars over both shoulders and neck, and a large palpable spleen. In the peritoneal cavity there were a few dense adhesions binding the lesser curvature of the stomach to the inferior surface of the liver. The spleen was

Fig. 5. Anteroposterior roentgenogram taken thirty-seven days later, after injection of lipiodol into the right main bronchus. The bronchi are well visualized and are of normal size and configuration. Note the decrease of the cloudiness at the right base.

free. There were scattered adhesions on all surfaces of the right lung and about 100 c.c. of turbid fluid in the right pleural cavity. There were no adhesions or fluid in the left pleural cavity and pericardial sac.

Lungs: Left weighed 350 grams, was crepitant throughout, and except for slight emphysema, edema and injection of the bronchi showed no abnormalities. The right weighed 650 grams. The visceral pleura on all surfaces was thickened and over the lower lobe somewhat hyperemic and granular. The upper and middle lobes were crepitant throughout and somewhat soggy. The lower lobe was increased in consistency throughout and in its central portion near the hilus was felt a firm mass. On section the upper and middle lobes, except for moderate hyperemia, appeared normal. In the lower lobe near the hilus was an egg-shaped mass measuring approximately 7 x 3.5 x 3. 5 cm. It was sharply

demarcated. It was of uniform architecture. The cut surface was homogeneous, gray, granular, slightly moist. There were no secondary or "daughter" nodules. The larger vessels and bronchi were adherent and inseparable from

Fig. 6. Lateral view of the chest after lipiodol injection showing the normally filled bronchi in the right middle and lower lobes. The gumma is still present.

the mass (Fig. 2). The remainder of the lung was markedly hyperemic.

Microscopic Examination. Lung: Several sections through the necrotic mass showed large areas of homogeneous necrosis surrounded by zones of vascular granulation tissue. There were fibroblasts and mature fibrocytes. The cellular content of the granulation tissue was chiefly lymphocytic. There were occasional plasma cells and endothelial cells. The newly formed capillaries were thin-walled and here and there were small foci of perivascular lymphocytic infiltration. In some sections the necrotic zones were seen infiltrating and destroying the walls of small bronchi and vessels. In one section the wall was lined by a thin layer of stratified squamous epithelium, probably derived from a partly destroyed bronchus. In one section the necrotic area was adjacent to a large bronchus, the wall of which showed a marked diffuse lymphocytic and plasma cell infiltration with ulceration of the lining mucous membrane. The adjacent pulmonary parenchyma in all sections showed extensive edema, hyperemia, with leucocytic and mononuclear exudates in the alveoli. Here and there were small foci of purulent necrosis.

Sections from the left lung showed slight emphysema, moderate congestion and edema.

Liver weighed 2,050 grams. Capsule was thickened and roughened. There were large irregular, stellate scars on all surfaces most marked on the inferior and posterior. These scars varied from 1 to 3 cm. in diameter. On section the architecture was fairly well preserved except in the scarred areas which appeared soft, moist and fibrous. Gallbladder and ducts were normal.

Microscopic Examination. Liver: Several sections showed irregular scattered areas of scarring which in places were densely cellular and rich in lymphocytes and plasma cells, and in places scantily cellular, densely fibrous and highly vascular. The intervening parenchyma appeared normal.

Portal Vein: A section of the portal vein at the hilum of the liver showed marked fatty, fibrous and hyaline thickening of the intima.

Spleen weighed 1,600 grams and measured 27 x 17 x 7 cm. There were no abnormalities at the pedicle. The vessels were not thrombotic. The surface was smooth, the capsule somewhat thickened. On section the organ cut with increased resistance and presented a homogeneous, reddish-brown, smooth surface. The follicles were large. The trabeculae and vessels were not prominent.

Microscopic Examination. Spleen: Several sections showed markedly dilated sinusoids filled with red blood cells and a few leucocytes. In places the lining cells were cuboidal. There was a moderate increase of the stroma. The Malpighian bodies were of average size. Trabeculae and vessels were normal. The capsule was slightly thickened.

Sections of all organs stained for acid fast bacteria and spirochetes were negative.

Differential Diagnosis. The diagnosis of syphilitic gumma of the lung was made because the gross and microscopic findings were typical. The lesion was not like tuberculosis and there were no other manifestations of tuberculosis in the body. Actinomycosis, Hodgkin's disease, blastomycosis and all other known granulomata could readily be excluded. The situation and character of the lesion excluded infarct. The diagnosis was supported by the clinical evi-

dence of syphilis, the positive Wassermann tests and the typical hepar lobatum of syphilis.

The fact that at autopsy no pathologic changes could be found in the right middle lobe and that the gumma was not much smaller than it appeared to be on the original films, was interesting. It is probable that the decrease in size of the shadow was not due to the specific therapy and the subsequent shrinking of the gumma as was surmised, but to a clearing of a superimposed partial atelectasis of the right middle lobe. Seeing the pathologic specimen with the dense fibrous capsule around the gumma, one would hardly expect any response to specific therapy in a way of decrease in size. This case illustrates the fallacy of basing a diagnosis of syphilis entirely on the decrease of the size of the lesion, because despite the fact that the lesion turned out to be syphilitic, the gumma did not respond considerably to therapy, and only the shadow that was caused by a nonspecific process had cleared.

DISCUSSION

Virchow (quoted by Schilling[13]) in his article entitled "The nature of constitutional syphilitic affections" was the first to describe syphilitic lesions of the pulmonary and visceral organs. He emphasized the difficulty in diagnosing lung changes in luetic persons, and his statements still hold true. MacCallum's description of the tertiary stage of syphilis also emphasizes the difficulty in differentiating it from tuberculosis, especially in the lungs. This difficulty explains why syphilis of the lung is so rare an autopsy finding. Even the presence of spirochetes in a given pulmonary lesion is not diagnostic for syphilis by itself, for they are difficult to differentiate from saprophytic organisms which may enter the bronchial channel through inhalation, as for instance the *Spirochaeta dentium*.

Acquired tertiary syphilis of the lung is described by most authors as falling into three main pathologic groups (Assmann,[2] Wile and Marshall[14]):

1. The most common form is the interstitial fibrosing type, which originates from the hilus and extends downward along the lymph spaces and lymph vessels into the peribronchial, perivascular and interlobar connective tissue. A considerable amount of connective tissue is produced, which may undergo fibrosis and produce stenosis of some bronchi with secondary bronchiectasis. The hilus becomes enlarged through a connective tissue proliferation and glandular enlargement. The upper lung fields and the apices remain free.

2. The gummatous affection which produces areas of consolidation. Karsner[9] states that the gummata are usually single, firmer than tubercles, show more distinct marginal fibroses and are usually found in the right middle or upper part of the lower lobes. They rarely caseate and ulcerate, giving the clinical symptoms of a lung abscess. Gummata may be situated in the trachea also and may lead to severe stenosis of the air passages. Assmann[2] mentions a pathologically proved case, where a gumma in the trachea produced a complete stenosis and the patient died of suffocation. Gummata may be situated on the pleura also.

3. The diffuse, lobar syphilitic pneumonia, which corresponds to the pneumonia alba of infants is a rare form. Most authors doubt its occurrence in adults.

The clinical diagnosis can only be established by careful clinical, roentgenological and laboratory studies, and by exclusion of other lung lesions.

Howard[7] in 1924 gave five diagnostic criteria for the diagnosis of syphilis of the lungs: (1) Absence of grave symptoms such as fever, sweating or emaciation proportionate to the physical signs in the lungs; (2) sputum examination negative for the tubercle bacillus; (3) presence of other stigmata of syphilis such as lesions in the bones, skin and mucous membranes; (4) positive Wassermann reaction, and (5) response to antisyphilitic therapy as controlled by roentgenograms.

However, we have to keep in mind that not every pulmonary process in a syphilitic individual that undergoes absorption or resolution during antiluetic treatment must necessarily represent a cured case of pul-

monary syphilis, as an exudative type of tuberculosis may also undergo complete resolution in a short period of time. Allison[1] suggested for non-autopsied cases the following roentgenologic criteria: (1) The patient should have serial films showing the disease to be progressive without treatment. (2) Films taken after the specific therapy should show a retrogression. (3) Subsequent films should demonstrate a disappearance of the lesion.

We believe that the cases which show improvement are mostly of the gummatous type, for Schlesinger (quoted by Hammer[5]) has shown that in the indurative interstitial type, which is commonly associated with bronchiectasis, not much, if any, improvement can be expected from specific therapy.

Roentgenologically in the indurative, interstitial type there is an enlargement of the hila with dense striped shadows radiating into the middle and lower lung fields. The right lower lobe is a favored site of the involvement. The striped shadows may be confluent around the hila. Small, round and irregular nodes may be scattered along the path of the striped shadows. The lesion is more marked in the central part of the lungs than in the periphery. If some of the strands extend into the upper lobes, then the appearance may be identical with that seen in chronic passive hyperemia.

If bronchiectasis develops, a characteristic cobweb appearance of the involved area occurs. Through the shrinking processes the mediastinum may be pulled over to one side and the diaphragm may become irregular in outline and elevated. Pleural effusions, thickened pleura, atelectasis and bronchopneumonia are all possible complications making the roentgen interpretation more difficult.

The gummata vary in size from small miliary nodes to large tumor-like structures. The right middle and lower lobes are the most common sites, but the lesions may occur in any part of the lung field. The gummata may be sharply defined and round, but if there is considerable connective tissue fibrosis around it, it may be irregular. The gumma may show evidence of central cavitation. The differential diagnosis between gumma and primary or metastatic tumors is difficult.

The roentgen appearance of pulmonary syphilis is manifold and depends on the type of lesion and complicating factors. The most common feature is the basal distribution of the involvement. No diagnosis of pulmonary syphilis can be made from the roentgenograms alone, but the simultaneous occurrence of an aortic configuration of the heart shadow, a dilatation of the aorta or involvement of the bony parts of the thorax with a purely basilar lesion should make the roentgenologist suspicious of this possibility.

Among the clinical features the most important is the dyspnea. There is usually some mucopurulent expectoration and cough in the interstitial fibrosing type. The onset of the disease is gradual and many patients do not remember when their disease began. There is some loss of weight and appetite. There may be an elevation of the temperature up to 37.5°–38.0° C. Some patients have no fever. The gummatous type of lesion causes fewer clinical symptoms and the discrepancy between the patient's relative well being and the large area of consolidation as shown on the roentgenogram should lead the clinical diagnosis toward pulmonary syphilis.

From a differential diagnostic standpoint both clinically and roentgenologically tuberculosis has to be considered. Against tuberculosis is the absence of fever or only a slight fever in the face of a definite pulmonary lesion. The sputum is negative for tubercle bacilli and the apices are free from involvement. In cases of ulcerative gummata of the trachea and bronchi there may be repeated hemoptysis over a long period of time without roentgen evidence of cavity formation, which would be unusual for tuberculosis. The clinical history of venereal infection, the positive blood Wassermann test, and changes in the pupil reactions, or evidence of syphilis of other

organs, as in our case, are all additional confirming factors.

The differential diagnosis between malignant tumors of the lung is a question of time element, as malignancies are rapidly progressing. Patients with syphilitic lung disease usually give on admission a history of long duration of illness, incompatible with a malignant process.

Chronic pneumonias may simulate syphilis, but in the former disease there is a history of acute onset.

Consequently the diagnosis can be established only by close cooperation of roentgenologist and clinician. The roentgenologist should be aware of some of the peculiarities of the roentgen shadows of this disease and suggest the possibility to the clinician. The final diagnosis can be made only by the clinician, by excluding other diseases with the aid of laboratory tests, clinical history and careful clinical observation.

SUMMARY

1. A proved case of pulmonary syphilis is reported.

2. The roentgen appearance was that of a pulmonary malignancy.

3. Decrease in size of a basal lesion in a known luetic person after antiluetic therapy is not necessarily indicative that the pulmonary lesion is syphilitic.

4. The diagnosis must be made by a coordination of clinical, roentgenological, and laboratory findings.

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THE PATHOLOGICAL APPENDIX*

By JOSEPH FELSEN, M.D.
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THE purpose of this communication is to present a correlated clinical, pathological and roentgenographic study of 500 appendices. It is not my intention to review the data already furnished by many excellent monographs on the subject, notably those of Aschoff, Renn and Masson, in recent years, but rather to point out certain new observations with regard to the pathology and roentgenographic appearance of the appendix after operative removal.

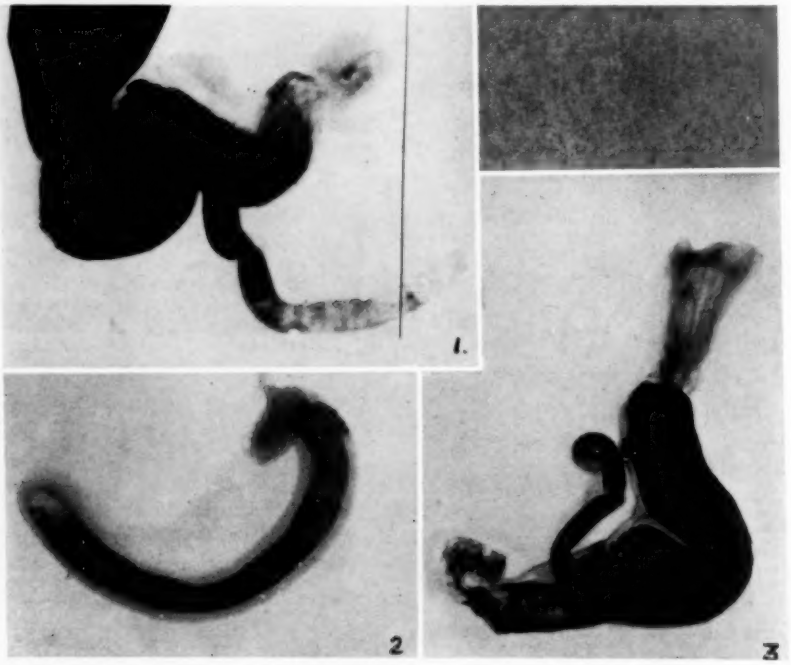


PLATE I.

1. Ileo-cecal-appendicular region in full term newborn. Note uniformly smooth outline of appendicular canal and thin wall.
2. Normal appendix in adolescent child. Note increased thickness of wall as compared with 1 and 3.
3. Ileo-cecal-appendicular region in fetus, 7 months. Illustrations in this as well as other specimens are contact prints, being actual size of specimen.

THE PROBLEM

During the course of many years of hospital experience, covering the examination of perhaps 10,000 appendices, there has occasionally occurred a discrepancy between the diagnosis made at the operating table and that made by the pathologist. This difficulty to my mind is in part due to the almost universal custom of opening the appendix longitudinally and selecting for transverse section that portion suggestive of pathology to the naked eye. There are many factors which render such a procedure rather unreliable. I shall only mention two of them. First, early inflammatory lesions limited to the mucosa and consisting almost entirely of lymphoid hyperplasia and slight edema often give no gross evi-

* From the department of Laboratories and Medical Research, Bronx Hospital, New York City. This paper was read, and a complete exhibit of the mounted gross specimens, histopathology and X-ray films shown at the annual meeting of the Bronx Pathological Society on December 20, 1932.

TABLE I

NORMAL APPENDIX

	New-born	Adolescent	Adult
(A) Roentgenographic Characteristics			
Wall	Thin	Thicker	Similar to those of child except for size
Canal	Uniform Smooth Relatively broad (3–4 × thickness of wall)	Narrower	
(B) Histological Characteristics			
Crypts	Numerous Narrow Superficial	Most evident between separated lymph nodules	Similar to adolescent
Lymph nodules	Few	More numerous	Extremely variable; flattening after 50th yr.
Muscularis mucosa	Uninterrupted	Most evident between separated lymp nodules	Similar to adolescent
Submucosa	Thin	Thicker	
Muscularis	Thin	Thicker	

TABLE II

PATHOLOGICAL APPENDIX

	Early Acute	Late Acute	Chronic or Healed
(A) Roentgenographic Characteristics			
Wall	Slightly thickened	Thickened or perforated	Thickened or atrophic
Canal	Sawtooth or stalactite appearance or scalloped outline	Stenosis (edema) or widening (ulceration)	Stenosis or widening or obliteration
(B) Histopathology			
Crypts	Wide and deep	Edema Cellular infiltration	Diminution or absence
Lymph nodules	Hyperplastic Reticular cell hyperplasia Edematous Marginal ring scattered poly. leucocytes	Disintegration	Hypoplastic
Mucosal stroma	Edematous	Hypertrophy of all normal histological structures	
Submucosa			Thickened
Muscularis			Thickened

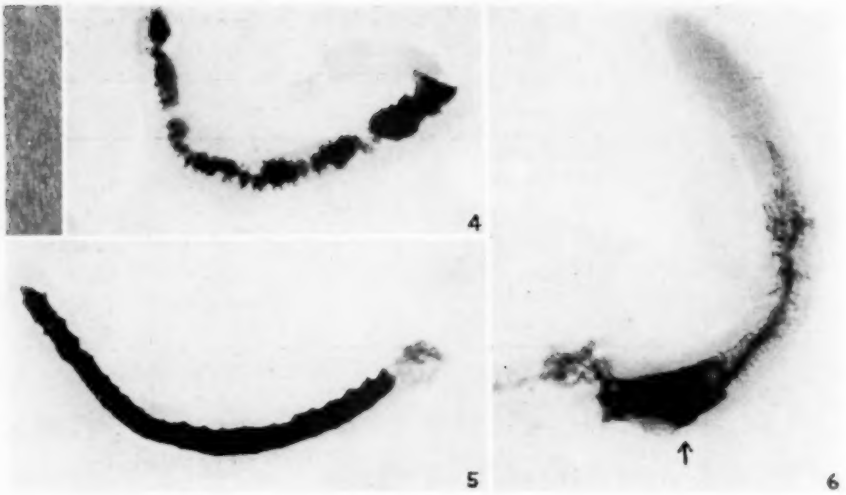


PLATE 2.

4. (#3115) Early acute appendicitis. Male, age 25 years. Duration of symptoms 12 hours. Pain, tenderness, rigidity right lower quadrant. Leucocytes 23,000 per cu. mm. with 92 per cent of polymorphonuclear forms.
Note irregular contour of canal (alternate areas of constriction and dilatation) and beautiful stalactite-like formation seen in early acute appendicitis before extensive mucosal necrosis occurs. Appearance due to widening and deepening of crypts of Lieberkühn.
5. (#3307) Acute appendicits with marked lymphoid hyperplasia. Female, age 18 years. Pain, tenderness and rigidity over entire abdomen accompanied by vomiting. Duration of symptoms 4 days. Admission temperature 101 degrees F. Leucocytes 17,500 per cu. mm. with 80 per cent of polymorphonuclear forms. Note scalloped appearance of canal due to protrusion of mucosal epithelium because of underlying hyperplastic acuminate solitary lymph nodules.
6. (#3504) Acute appendicitis in child of 5½ years with perforation at base. Pain, tenderness and rigidity right lower quadrant. Duration of symptoms 36 hours. Leucocytes 20,000 per cu. mm. with 86 per cent polymorphonuclear forms. Localized abscess found at operation.
Note marked necrosis of proximal portion where canal is greatly widened, arrow pointing to site of perforation. Beyond this area mucosa still intact and crypts widened, giving typical stalactite appearance.

dence of their presence. Second, the appendix in its structure and resistance to bacterial infection has many points of similarity to the colon of which it forms a part. The point of divergence is in the blind terminal portion of the appendix and its relatively poor contractile power, both of which militate against adequate drainage. The inflamed appendix in many ways resembles the colon of idiopathic ulcerative colitis in which disease one often sees a peculiar clear cut segmental involvement and in which the organisms are apparently only a secondary factor. That is, the bacteria found in an inflamed appendix, as in the colon of idiopathic ulcerative colitis, are those normally present and only invade the wall when certain local or general protective mechanisms fail. I wish to call particular attention to segmental involvement of the appendix in both acute and chronic inflammation. This is a significant observation from the standpoint of the pathologist as failure to note a sharply limited segmental lesion will lead to an erroneous diagnosis.

In an attempt to eliminate these two factors, namely, the early and segmental lesions, the following procedure has been devised. Appendices received from the operating room are injected with a heavy suspension of barium in 5 per cent formalin, by means of a 10 c.c. syringe and 18-gauge needle, the bevelled point of which has been filed down to a perpendicular. This is done to prevent artifacts. The needle is

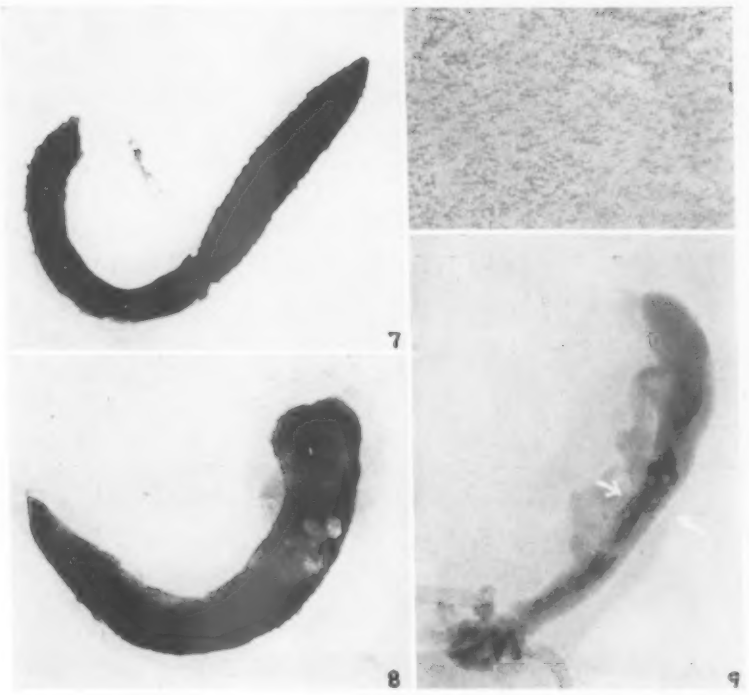


PLATE 3.

7. (#3268) Acute appendicitis. Male, age 9 years. Pain, tenderness and rigidity right lower quadrant accompanied by vomiting. Duration of symptoms 12 hours. Admission temperature 100 degrees F.
Note widening of canal due to extensive necrosis which does not however extend deep enough to obliterate deepest portion of crypts. The latter may be discerned as a fine shallow fuzziness.
8. (#3353) Acute gangrenous appendicitis with fecalithiasis in male child, 14 years of age. Pain in umbilical region radiating to right lower quadrant with tenderness and rigidity right lower quadrant accompanied by vomiting. Admission temperature 100.6 degrees F. Duration of symptoms 24 hours. Operative findings —gangrenous appendix lying in abscess cavity.
Note extreme mural thinning with marked dilitation of canal due to necrosis of all layers. Note fecalith.
9. (#4634) Segmental acute appendicitis in child 8 years of age. Pain in lower abdomen for 24–48 hours. Leucocytes 6,400 with 56 per cent of polymorphonuclear forms.
Arrow points to localized stalactite area of inflammation. Only sections taken through this small area will show acute appendicitis.

PLATE 4.

Magnification ×240. Early acute appendicitis. Note open mouths and fundi or crypts of Lieberkühn. Barium getting into these opened crypts gives typical stalactite appearance seen in X-ray.

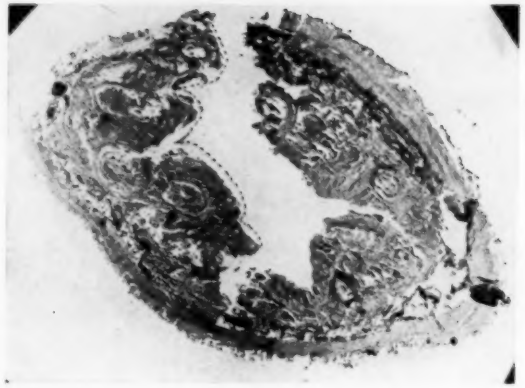


PLATE 5.

Magnification ×20. Acute appendicitis with lymphoid hyperplasia, quite common in children. Dotted line explains scalloped appearance of barium column seen in Plate 2, No. 5. Arrows point to hyperplastic acuminate lymph nodules.

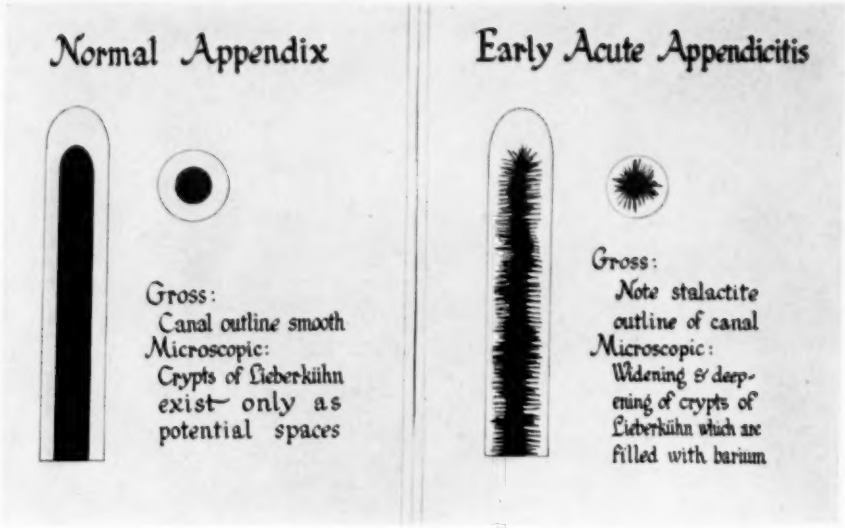
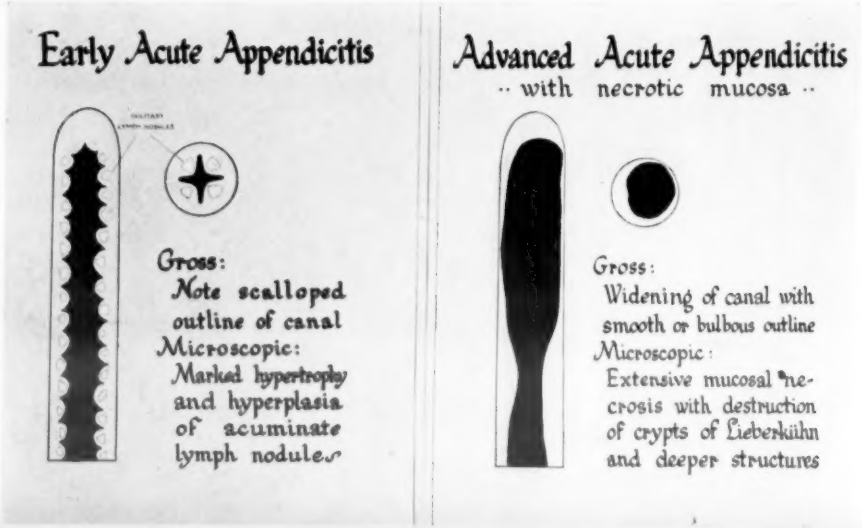


PLATE 6.


Early Acute Appendicitis
Gross:
Note scalloped outline of canal
Microscopic:
Marked hypertrophy and hyperplasia of acuminate lymph nodules
Advanced Acute Appendicitis
·· with necrotic mucosa ··
Gross:
Widening of canal with smooth or bulbous outline
Microscopic:
Extensive mucosal necrosis with destruction of crypts of Lieberkühn and deeper structures
Segmental Appendicitis
Gross:
Only part of appendix inflamed
Microscopic:
Accurate pathological diagnosis only if section taken from characteristic area

inserted just within the appendicular canal and only sufficient pressure exerted to fill the organ. As the excess barium wells out through the proximal end the needle is removed. The appendix is then gently massaged in order to facilitate permeation. The proximal end is tied and tagged for identification and washed in running water to remove any excess barium. It is then x-rayed. Stereoscopic films have been taken but appear to have no advantage over the usual flat plate from the standpoint of the pathologist. Fluoroscopy alone is quite unsatisfactory. The canal contour is seen clearly on the film even to its fine lateral ramifications where these are present. Small air bubbles do not materially interfere with the visual impression. Fecaliths or other foreign bodies stand out clearly and are often associated with contiguous atrophic changes in the appendicular wall. Stenosis, obliteration of the canal in part or as a whole, variations in mural thickness, are quite apparent. Early acute inflammatory lesions, local or general, are evidenced by a peculiar fine sawtooth or stalactite canal outline, apparently due to an increase in width and depth of the crypts of Lieberkühn associated with some edema and cellular infiltration of the mucosal stroma. Scalloped, shallow excavations along the canal outline appear to be due chiefly to hyperplasia of the lymph nodules.

I shall attempt to summarize the roentgenographic findings in 500 appendices, indicate their pathological interpretation and correlate both with the clinical data.

I wish to express my appreciation of Dr. Harry M. Imboden's interest in these studies, and thanks to Dr. William Snow for the use of the technical facilities of the roentgenographic department.

INTRAPELVIC PROTRUSION OF THE ACETABULUM

(OTTO'S PELVIS)

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INTRAPELVIC protrusion of the acetabulum, or Otto's pelvis, is a descriptive term of an uncommon hip condition in which there is a deepening of the acetabular cavity due to a medial displacement of the inner wall into the pelvis. The heads of the femurs follow the receding acetabular walls. The etiology is not definitely known. The condition was first described by Otto[5] in 1824. It is a slowly progressive disease with only a moderate destruction of the acetabular cartilage and the preservation of the general contour of the articulating surfaces. It is usually accompanied by a disturbance of the function of the hip joint, chiefly of abduction and rotation, less of flexion and extension.

Relatively few cases of Otto's pelvis are recorded in the literature, and most of these are in German. Hertzler (1922)[2] contributed the first article to the American literature. Since that time Lewin,[3] Doub,[1] and Pomeranz[4,5] have described cases. Pomeranz collected from the literature 79 instances of intrapelvic protrusion of the acetabulum. He considered 41 of this number to be true Otto's pelvis, and contributed 6 additional cases of his own. Intrapelvic protrusions resulting from tuberculosis, osteomyelitis, nerve diseases, and malignancies are excluded.

We are presenting 2 typical cases of bilateral intrapelvic protrusion of the acetabulum. Although the etiology of this condition is not definitely established, it is necessary to abandon the theory that intrapelvic protrusion of the acetabulum is a disease entity. We believe the cases presented would fall into that idiopathic group of nonspecific arthritis, or osteoarthritis. This conclusion regarding classification agrees with that of Hertzler[2] and Lewin.[3]

CASE REPORTS

Case 1. The patient, a woman aged fifty, came to the Cleveland Clinic Hospital on January 2, 1929, because of a goiter which had increased gradually in size for twenty years. She presented the typical clinical picture of hyperthyroidism. She had been married for thirty years; she had had ten pregnancies, and, during each, the size of the goiter had increased definitely. Eight children were living and well; one was insane. There had been one miscarriage. There was no history of difficult or abnormal labor.

At the age of forty, the patient had begun to suffer from rheumatism which first affected the right knee and the right hip. Later, the right leg had become shorter. Nine years after the first rheumatic symptoms, stiffness had developed in the right knee and right hip. The joints became stiff with inactivity and painful with exercise. The pain was relieved by rest. The patient's mother was said to have suffered from a similar type of rheumatism. She had never received treatment for her joint trouble.

The patient had three dead teeth on the lower jaw which were considered as a possible focus of infection. There were also numerous dental fillings; the upper jaw was edentulous. The tonsils were cryptic, with red pillars. The thyroid was diffusely enlarged to six times the normal size and many small and large nodules were palpable. No abdominal masses were palpable. There was a small cystocele and laceration of the cervix, but no intrapelvic masses. She was quite stooped but spinal movements were normal. There was marked fixation in the right hip joint and movements in the left hip joint were limited. There was bilateral hallus valgus and marked pes planus. Heberden's nodes were present.

Laboratory examinations yielded essentially normal findings. Roentgenographic studies showed small femoral heads with considerable atrophic change. The acetabulum on each side protruded into the pelvis, with about one-

third of each femoral head displaced inside the pelvis. This caused bilateral shortening of about three-fourths of an inch and the greater trochanters rested against the iliac bones (Fig. 1).

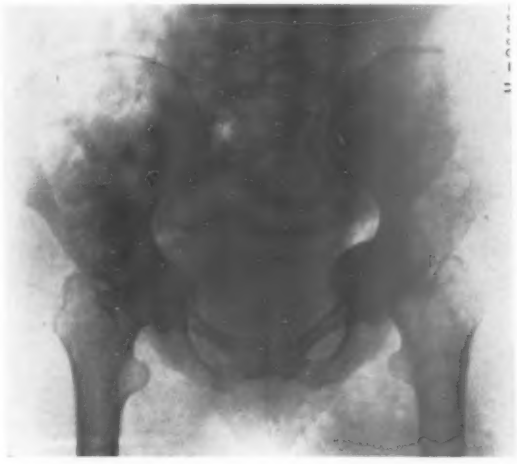

Fig. 1.

The clinical diagnosis in this case was adenomatous goiter with hyperthyroidism, auricular fibrillation with beginning decompensation, and hypertrophic polyarthritis, most marked in the hip joints.

A right thyroid lobectomy was performed on January 17, 1929, and a left lobectomy was done July 8, 1929. The pathologic diagnosis was colloid goiter with multiple colloid adenomata. No attempt was made to treat the joint trouble on account of the patient's general condition. The patient died at her home two years later, probably from cardiac decompensation.

Case II. A rather obese woman, aged sixty-seven, entered the Clinic in April, 1931, complaining of "rheumatism." Ten years before the patient had begun to suffer with occasional pains in the joints which involved all joints at times. Movement caused severe pains in the knees and hips which decreased when the patient was at rest. She complained particularly of the hands, elbows, knees, ankles and hip joints. These frequently became tender and swollen. Several years before the teeth had been extracted without relief. Her pains had increased much in severity just preceding admission to the Clinic, especially following an attack of influenza during the winter. She was rather susceptible to colds and throat irritation. Constipation was severe. She was relieved of her joint pains by hot applications and rest. The family history was essentially unimportant. She had been married for fifty-one years and had been pregnant eleven times. Seven children were alive and well, two had died of tuberculosis, and two pregnancies had resulted in miscarriages.

The patient had had the usual diseases of childhood. A cervical laceration had been repaired fifteen years before, and three years afterwards, appendectomy and cholecystectomy had been performed.

The tonsils were of moderate size, and some liquid exudate could be expressed. The mouth was edentulous. Clinical examination of the thorax, abdomen and pelvis revealed no significant abnormality.

The knees were swollen and there was increased local heat; there was crepitation with limitation of flexion beyond 90°, but full extension was possible. The hip movements were free. There was some restriction of movement in the lower portion of the spine. Extension of both elbows was limited to 15°. Periarthritis was present in both shoulders, but was more severe in the left side. The urine and blood were normal. The basal metabolic rate was minus 7 per cent.

Roentgenographic studies of the stomach, gallbladder, small and large intestines showed no abnormality except some spasticity of the colon. Marked hypertrophic changes in the

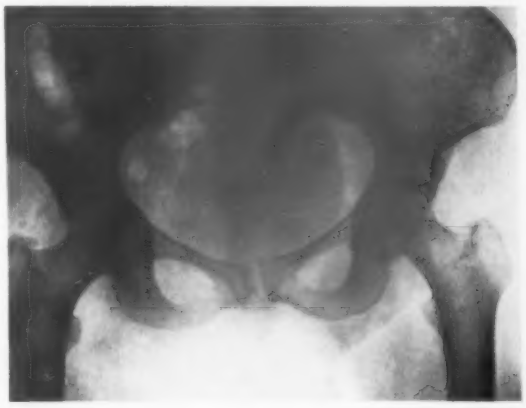

Fig. 2.

lumbar spine, some destruction of cartilage in the hip joints, hypertrophic changes and a slight bilateral medial displacement of the acetabula and femoral heads into the pelvis (Fig. 2), some hypertrophic changes at the symphysis

and hypertrophic changes in the right knee, involving particularly the patella, were noted in the roentgenograms. We believe this patient had proliferative arthritis with a moderate degree of protrusion of the femoral heads into the pelvis.

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Vol. XXXI, No. 3

ROENTGEN FINDINGS IN AINHUM

By LEWIS J. FRIEDMAN, M.D.
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AINHUM is probably a trophic lesion affecting the toes of the natives of the tropics. Very scant reference to this condition is made in the literature. The dictionaries describe ainhum as a spontaneous amputation of a toe by a constricting fibrous ring, affecting chiefly male negroes in the tropics. The name is derived from an African (Nagos) word meaning to saw.

CASE REPORT

Male, negro, aged thirty-five, American of at least three generations, was admitted to the skin clinic suffering from pain in the fifth toe of the right foot. He described the pain to be of a constricting nature, occurring usually in the afternoons and of several months' duration.

Physical examination of the affected toe revealed a "linear constriction at the interphalangeal articulation, the groove most pronounced on the flexor surface. The distal end of the toe was slightly indurated. The fibrotic furrow had not yet encircled the toe completely." (Tulipan.)

The roentgenogram revealed a shadow across the toe corresponding to the location of the furrow described above. The distal half of the middle phalanx was absorbed and several small bone fragments were visible. The distal portion of the stump of the phalanx was pointed and smooth. The distal articulating facet remained and was in close proximity to the phalangeal joint. The terminal phalanx appeared slightly osteoporotic. The other bones of the foot were normal.

Although the roentgen findings in ainhum should not cause confusion with other similar lesions, Raynaud's disease, leprosy and thromboangiitis obliterans may be

FIG. 1. Ainhum. Arrows point to shadow cast by the deep furrow, and bone fragments.

mentioned; these can be readily eliminated by the atrophy and destruction occurring in the *distal* phalanges, and the absence of a constricting band.

ROENTGEN TREATMENT OF BENIGN HYPERTROPHY OF THE PROSTATE GLAND*

By BENJAMIN S. BARRINGER, M.D., ARCHIE L. DEAN, JR., M.D., RALPH E. HERENDEEN, M.D., *and* JAMES J. DUFFY, M.D.

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NOTWITHSTANDING its decreased mortality of latter years prostatectomy is still a major operation. There are many patients who cannot be subjected to this operation. Various compromising measures have been used in order to evade prostatectomy, viz., catheter life, suprapubic drainage, incomplete intraurethral operations, and prostatotomy in various forms.

Four years ago we became interested in determining just what, if any, was the effect of subjecting patients with hypertrophied prostates to high voltage roentgen therapy. The primary object of this work was to see if in any appreciable number of patients operative removal of hypertrophied prostates might not be replaced by such therapy.

We report 34 cases in which a sufficient trial of deep roentgen therapy over a sufficient length of time has enabled us to obtain an idea of its real value. Some of these cases we have observed for a number of years. We have separated the cases rather arbitrarily into two groups: those in which the residual urine was 60 c.c. and over, and those in which it was under 60 c.c. The cases in the first class represent those in which prostatectomy would be proposed

TABLE I

TWENTY-THREE CASES IN WHICH THE RESIDUAL URINE WAS 60 C.C. OR MORE. SHOWING THE EFFECT OF DEEP ROENTGEN THERAPY UPON THE RESIDUAL URINE AND UPON THE SYMPTOMS

Residual urine decreased to little or none	Residual urine the same	Residual urine increased
7	12	4
Symptoms better	Symptoms same	Symptoms worse
10	10	3

TABLE II

ELEVEN CASES IN WHICH THE RESIDUAL URINE WAS LESS THAN 60 C.C. SHOWING THE EFFECT OF DEEP ROENTGEN THERAPY UPON THE RESIDUAL URINE AND UPON THE SYMPTOMS.

Residual urine the same or decreased		Residual urine increased
9		2
Symptoms better	Symptoms same	Symptoms worse
5	6	

Of these 34 cases (Tables I and II) which were treated by deep roentgen therapy, 4 came to prostatectomy and 4 more were advised to have prostatectomy.

* This research was carried out under the Guggenheim Fund for Urology.

by most urologists. We have tabulated the effects of the treatment upon the residual urine and upon the symptoms. In the first class 7 out of 23 cases showed a decreased residual urine and improvement of symptoms. *In these 7 (30 per cent) operation has been very definitely avoided. This probably represents fairly well what deep roentgen therapy can do, and its limitations.*

PATHOLOGICAL CHANGES ASSOCIATED WITH PROSTATISM

Before adopting any therapeutic measures it was necessary to define clearly the pathological changes associated with prostatism. This involved a study of: (1) the more remote effects produced by the enlarging gland; (2) the histological structure of the hypertrophied prostate.

As the prostate gland increases in size it forms an obstruction in the posterior urethra and also gradually raises the bladder outlet to a higher level than that of the bladder base. As a result the patient is unable to empty the bladder completely. This is demonstrated by the routine urological procedure of performing catheterization immediately after micturition and measuring the amount of "residual urine" withdrawn. Owing to the fact that enlargement of the prostate is a progressive disease, the amount of residual urine increases. Sooner or later infection becomes established in a bladder which harbors stagnant urine, and the patient suffers discomfort from polyuria and dysuria. From the earliest stage of obstruction pathological changes take place in the bladder wall.

Of greatest importance, however, is the damage sustained by the kidneys. With the ureteral orifices situated in the bottom of the well of residual urine, the kidneys are forced to excrete against an ever increasing "head" of pressure. Since these organs contain no muscle tissue which could hypertrophy as the excretory demands increase, the renal parenchyma becomes gradually compressed between the dilating pelvis and the capsule. Kreutzmann, who has made a careful study of renal back pressure, believes that the condition is due primarily to obstruction at the bladder outlet but that hypertrophy of the bladder musculature causes a stenosis of the intramural portion of the ureter which is followed by dilatation of the renal pelves and upper ureters in a large percentage of cases. Frequently infection ascends to the kidneys by way of the ureters. Regurgitation of infected urine may be propelled by straining which attends the act of micturition. With free drainage from the kidneys into the bladder impaired, conditions are ideal for infection to become established. This morbid condition is conducive not only to impaired renal function per se, but also to degenerative changes within the cardiovascular system.

HISTOLOGICAL CHANGES IN THE HYPERTROPHIED GLAND

The following histological changes may be enumerated as occurring in the hypertrophied prostate gland. Of course they are found in various combinations in different specimens. These changes are: multiplication and dilatation of the acini; stagnation of secretion; degrees of hyperplasia of epithelium reaching almost adenomatous grades in some cases; increase of connective tissue stroma; much increase of smooth muscle tissue; more rarely small myomas are found, and occasionally some considerable areas of the prostate are made up of muscle tissue. In the more advanced stages there is fibrosis, diffuse and focal lymphocytic infiltration, edema, and occasionally polymorphonuclear leucocytic exudation. There may be rupture of acini and miliary abscesses. The prostatic urethra is nearly always involved by edema and lymphocytic exudate. In the active stages there is general venous congestion. Of these pathologic changes the lymphocytic infiltration, smooth muscle tissue and epithelial overgrowth, congestion and edema are unstable factors and as such might be amenable to suitable forms of therapy. On the contrary, fibrosis is stable and resistant.

Of the changes which attend enlarge-

ment of the prostate gland, the presence of residual urine is of the greatest basic importance. In addition, damage to the bladder, ureters and kidneys is practically always in direct proportion to the amount of residual urine. For this reason any therapeutic measure directed toward the relief of prostatism must possess efficacy in diminishing the amount of residual urine. Even though a form of treatment clears up every other symptom it must be considered as without permanent value if the amount of residual urine remains unaffected. For these reasons our principal criterion of the results obtained has been variation in the amount of residual urine. This has been determined in each case on the basis of many careful measurements.

When we decided to employ high voltage roentgen rays in the treatment of benign hypertrophy of the prostate, we were influenced by several articles which had been published during the preceding few years. Claims were made that patients received great benefit after roentgen irradiation even when low voltage therapy had been administered. However, in no series of cases had there been careful estimates of the effect of the treatment upon the quantity of residual urine. Improvement was based upon diminution of polyuria and dysuria.

EXAMINATION AND TREATMENT OF CASES

In any work undertaken with the purpose of obtaining an accurate evaluation of a therapeutic procedure, one must avoid, whenever possible, the influence of extraneous factors, especially those in the nature of therapy. Otherwise the effects of the principal agent may become modified or obscured. Unfortunately, in the present clinical investigation it became necessary on several occasions, because of our obligations to the patient, to resort to more than one measure in order to relieve a temporary emergency. In two instances it was necessary to use an indwelling catheter to relieve total retention. Furthermore, since the stagnation of secretion is such a constant finding in the hypertrophied prostate, massage of the gland was performed systematically. While we recognize that these measures superimposed upon the irradiation mark deviations from the ideal, still their inadequacy in a curative sense is well known and no issue could be taken to their employment simply as adjuvants.

In the selection of our patients one requisite was demanded, namely, a measurable amount of residual urine.

After the initial examination the patients were usually seen several times by the urologist in order to make an accurate estimation of the amount of residual urine, and furthermore to learn how much improvement could be obtained by catheterization, irrigations, massage of the prostate, and perhaps the use of medication for the relief of urinary infection. Then the patient was referred to the roentgenologist for treatment.

It is possible that we made a mistake at the very start in not subjecting each of our patients to a cystoscopic examination in order to determine precisely the variety of prostatic hypertrophy present in each case. Such an examination would unquestionably have added to the accuracy of our information and would probably have given a better clue as to the cases in which roentgen therapy may be expected to prove efficient. For various reasons cystoscopy was not done routinely. In those cases in which it has been done valuable information has resulted.

In the beginning of this clinical investigation, the roentgen-ray dosage very nearly approached an erythema. The number of portals varied from one to four. The vesical reactions were often severe immediately following such treatments. It is not known why such reactions occurred; there is no known factor in the prostate itself. Possibly it was related in some way to infection either in the bladder or the prostate. The number and type of bacteria may be a determining factor in the severity of the postirradiation reaction. To decrease

or eliminate these untoward symptoms following irradiation of the prostate, the dosage was decreased to about one-fourth of an erythema, to each of three portals, suprapubic, sacral, and perineal regions, the beam directed toward the base of the bladder. These are given every second day.

THE FACTORS IN THE ROENTGEN TREATMENT

The technique of administering the dose selected has varied with the individual, and, of course, numerous factors have entered into the selection of the dose and the method of administering it. It is obvious that the selection of the dose and method of administering it is the most important function of the roentgenologist. He is supplied with all of the data necessary to determine the amount of radiation by the urologist who examines the patient from time to time, during and after the treatments have been started, and in accordance with the changes he observes, the roentgenologist varies the dosage; 200 kv., 0.5 mm. aluminum filtration, at 50 cm. skin target distance is the high voltage set-up. The dosage at each exposure amounted to about 200 r. The same series of treatments are repeated after an interval of ten days.

The third cycle, or even the fourth, is decided upon after later urological examinations.

The small dosage has been given to decrease reactions. The repeated doses are given for the theoretical reason that this method produces more fibrosis.

The cause of the beneficial effect of irradiation is not known in most instances. It is probably not a primary effect on the prostatic tissue, for the tissue dose at that depth is too small. The average distances from anterior and posterior surfaces of the body of the prostate are about 10 cm. The distance through perineum to prostate is about 6 cm.

Since the tissue dosage at 10 cm. depth is 36 per cent, one-quarter of an erythema delivered 9 per cent. Totalling the anterior and posterior doses, the prostate received 18 per cent from these fields, to which is added 16 per cent from the perineal field for a total of 34 per cent.

The effect has actually diminished about two-thirds before the second cycle is given. So it is clearly evident that destruction of tissue is not the cause of the benefits derived from irradiation of the prostate.

PROBABLE EFFECTS OF IRRADIATION

It is probable that the only effects of the irradiation in our series are a distinct decrease and control of the edema of the prostate. This has been noted clinically a number of times. The gland which previously had been edematous, boggy, and large, quite preceptibly became harder and smaller. This decrease in the edema of the prostate is frequently seen where a bladder is drained by a tube inserted suprapubicly.

It is possible that this edema is in part caused by a plugging of the ducts of the prostate, thus preventing an escape of the prostatic secretions. Decrease of the edema may cause a reëstablishment of the drainage of the prostate through its formerly plugged ducts. This is measured clinically by the amount of prostatic fluid which can be massaged from the prostate before and after roentgen treatment. We have seen several cases where there has been a marked increase in this fluid after the treatments.

An increase in the tissue dosage may give better results. This is to be tried. But the augmented dose will be given only after the first cycle is completed, to prevent too severe reaction of an initial heavy irradiation.

CASE HISTORIES

The following 2 cases represent ideal results:

M. C., aged sixty, came to the Memorial Hospital on February 8, 1927, with a history of seven years of recurrent attacks of complete retention of urine which had been relieved by catheterization. Of late the attacks had occurred every two weeks. When first seen the retention had been partially relieved by catheterization. He had 825 c.c. in the bladder. Urea blood nitrogen was 10.8. Rectal examination

showed a large, smooth, regular prostate. An indwelling catheter was placed in the bladder and on several subsequent trials removed with the hope that he might be able to urinate. All of these proved unsuccessful. Deep roentgen therapy and prostatic massage were instituted. On February 25 the catheter was removed for twenty-four hours. At the end of six hours he began to dribble urine but that was due to overflow of urine from a distended bladder. The indwelling catheter was reinserted. Deep roentgen therapy was continued. On several occasions it was attempted to take out the catheter but the patient continued to have complete retention. On March 13 the catheter was taken out and the patient began to urinate. His residual urine was 90 c.c., night urination four times, day urination every two hours. On November 11, his residual urine was 30 c.c., night urination once or twice, day urination every four hours. The patient has been observed for over two years and continues well.

F. S. G., aged seventy-five, came to the Memorial Hospital, November 15, 1928, with a history of night frequency of urination several times in number. Because of his prostatic condition his physician advised against his annual trip to Europe which he was in the habit of making. His prostate was soft, regular and somewhat mushy. A small amount of material could be massaged from his prostate. No cystoscopy was done. The residual urine was on several examinations 50 to 60 c.c. He was given roentgen treatments every third day or so—175 kv., 0.5 mm. aluminum filter, distance 30 cm., 30 ma., one to two minutes for 27 treatments. On November 28, 1929, he had a residual urine of 3 c.c., a good deal of prostatic secretion could be massaged from his prostate. He was getting up once or not at all at night. Since that time he is consistently emptying his bladder. He has had regular periods of prostatic massage and he has made his European trip three times with no trouble as far as his prostate is concerned. In June, 1933, he still empties his bladder.

We have 2 cases in which the effect of the roentgen therapy apparently enabled us to make a diagnosis of carcinoma of the prostate. There are certain cases of prostatic carcinoma which are accompanied by a very marked edema of the prostate. This edema masks the underlying carcinoma. When the edema vanishes under the roentgen treatment the hard irregular carcinoma is revealed.

The history of one such case is of much interest.

G. H., aged sixty-three, first came to the Memorial Hospital on October 18, 1927. His chief complaint at that time was that during the last year his urinary stream had been slowing up and he had trouble to start it. On September 5, 1927, the patient had a chill, and pus was found in the urine. Rectal examination revealed a very large, elongated, edematous prostate. It was symmetrical in outline and elastic in consistence. On several examinations the residual urine was found to be 60 c.c. The urine was hazy with pus. Roentgen therapy was begun on October 19, 1927. On November 20, 1927, a great alteration in the prostate gland was noted. Previously it had been large and smooth, now it was considerably smaller, and a band of induration, undoubtedly carcinoma, was felt which extended from the apex upward to the right side to the seminal vesicle. He had several courses of deep roentgen therapy. His residual urine was reduced to nothing. He has remained well to date, 1932, and at the present time there is no suggestion of carcinoma in his prostate. While we have no pathological evidence, I believe that he had a carcinoma of the prostate which was highly radiosensitive and the small amount of radiation which he received was sufficient to control this.

Another case, not at all brilliant as showing the results of roentgen treatment, illustrates what type of case may respond to this treatment.

J. D., aged sixty-three, came to the Memorial Hospital on November 20, 1920, with a history of difficult, frequent and burning urination dating from two years before. These were aggravated by taking alcohol. Just before being seen he had an attack of complete urinary retention which was relieved by catheterization. His prostate was twice the normal size, symmetrical and elastic. He had 70 c.c. of residual urine on two examinations and no residual urine on a third. His prostate by cystoscopy showed a decided bilateral enlargement with hardly any posterior commisural hypertrophy. Roentgen treatment decreased the residual urine to none and reduced the size of the prostate. He was examined

many times during the next three years but was found to have absolutely no residual urine. Then in January, 1932, after drinking an excess of alcohol he had another complete urinary retention. This responded to catheterization, but he had on several examinations 60 to 80 c.c. of residual urine. He should probably have more roentgen treatment.

SUMMARY

In 30 per cent of cases of hypertrophied prostate which otherwise would come to operation, deep roentgen irradiation reduces the residual urine and controls the symptoms.

The edematous prostate entirely loses its edema under the treatment.

How many prostates are removed because of this complicating edema is difficult to estimate. The only method of handling edema of a prostate causing a sudden increase of urinary retention has been in the past by means of indwelling urethral catheter or suprapubic drainage. Roentgen irradiation seems to offer an efficient method of combating this edema and this is probably all that it does.

At the present time when our eyes are turned toward the newer method of intravesical removal of the prostate by electrosurgical means, we must admit that the favorable results of this procedure are far from 100 per cent perfect. We in addition do not in the least know how permanent are the results of this method. If in 30 per cent of cases of hypertrophied prostate which have sufficient symptoms to indicate some surgical intervention, we can evade operation by roentgen therapy we have accomplished something well worth while.

Further experimental work will probably reveal what variety of prostatic enlargement will respond to roentgen therapy. A complete cystoscopic examination of the prostate is essential in order to determine accurately the type of prostatic hypertrophy present.

It is probable that the "simple bilateral lobe hypertrophy" so well described by Randall[1] is the type most suited to respond to this therapy.

In those patients in whom, for one reason or another such as poor heart, advanced age, bad kidney function, operative interference of any kind is contraindicated, deep roentgen irradiation should be the therapy of choice.

[1] Randall, Alexander. Surgical Pathology of Prostatic Obstructions. Williams and Wilkins Co., Baltimore, 1931.

STUDIES IN THE DIAGNOSIS AND TREATMENT OF TERATOMA TESTIS*

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THE DIAGNOSIS of lesions of the testis is not an easy matter. Dean has pointed out that the correct diagnosis of teratoma testis is so rarely made that of 124 patients seen by him at Memorial Hospital only 11 per cent were found free from local recurrence or metastasis on admission. This deplorable situation existed in spite of the fact that 70 per cent of these patients sought medical advice within the first six months of the disease.

It is easy to appreciate some of the reasons for the relatively low percentage of correct diagnoses in such cases. The incidence of teratoma testis is low. Pack, in a survey of 19,129 admissions to the Memorial Hospital, found 167 instances of teratoma testis. These tumors represented 2.09 per cent of all malignant tumors in the male and 3.39 per cent of all tumors of the genitourinary system.

The location of the tumor and the ease with which the testis may be removed lead many surgeons to perform an orchidectomy for persistent tumefaction of the testis in advance of correct diagnosis. The haste with which the testis is generally removed, in suspected cases, leads to a high percentage of local recurrence and metastasis before the true nature of the process is realized.

It may be said that there are no distinctive clinical features which distinguish teratoma testis clearly from the chronic inflammatory and traumatic diseases of the organ. Dean has summarized the methods of clinical diagnosis, which are well known, namely, palpation, transillumination, the Wassermann test to rule out lues, and the therapeutic test of the application of roentgen rays or radium. That the latter is not always indicative of the true nature of the disease has been noted in several instances at the Memorial Hospital where heavy doses of radiation have been applied to suspected teratoid tumors of the testis, the diagnosis later proved by section, and yet no diminution in size had taken place. The absence of regression in these instances is usually explained on the basis of hemorrhage or of the adult structure of the tumor.

If the surgeon who first sees a suspicious persistent tumefaction of the testis could be prevailed upon to delay operative interference until the diagnosis is accurately established, the death rate from the disease might be materially reduced.

It is worth while to make use of the newer methods of diagnosis and classification of the disease.

Of 59 new admissions for teratoma testis at the Memorial Hospital from October 1, 1930, to October 1, 1932, a period of two years, we were able to verify the diagnosis by histological examination in every case. Thirty-seven of these sections are available for review, and the patients have since been observed for an additional full year, to October 1, 1933.

All the patients with teratoma testis admitted since October 1, 1930, have had a routine quantitative study of the excretion of prolan A in the urine. The relation of the structural type of the tumor to the excretion of prolan A in the urine in these 37 cases is shown in Table 1.

The quantitative technique for the determination of prolan A in the urine for the purpose of differential diangosis of the various teratoid tumors of the testis has been related in detail elsewhere[12] and need not be repeated at this time. It is sufficient

* From the Urological Department and the Urological Research Laboratory, Memorial Hospital, New York City. With the aid of grants from the Mrs. Wortham James Fund and the Hon. Lucius Littauer. Read at the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

Table I

Structure	Cases	Limits of Initial Excretion of Prolan A before Irradiation
Embryonal adenocarcinoma	7	10,000–40,000 mouse units per liter of urine
Embryonal carcinoma with lymphoid stroma	15	2,000–10,000 mouse units per liter of urine
Seminoma	10	400– 2,000 mouse units per liter of urine
Adult teratoma	5	50– 500 mouse units per liter of urine

to point out that little advantage will accrue to the observer unless the quantitative technique is followed precisely and all qualitative methods are cast aside.

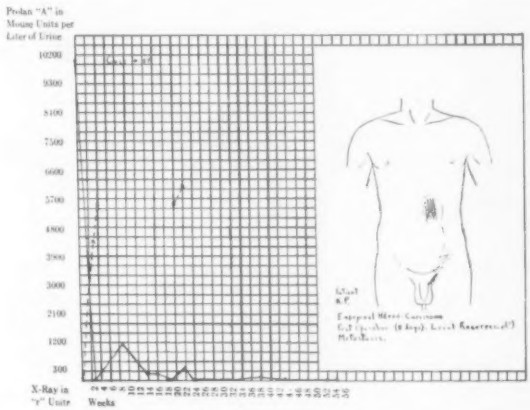
This paper presents a study of the relation of the biological behavior of the tumor to radiosensitivity, and to the pathological anatomy of the disease; and further relates these matters to the efficacy of different types of treatment, and shows that the best results in teratoma testis are to be had by careful routine study of the biological behavior of the tumor before, during and after irradiation.

Relation of Radiosensitivity to the Excretion of Prolan A

Of the 37 cases above mentioned, 14 were classified independently as either radioresistant or relatively so. Twenty-two were classified as radiosensitive or relatively radiosensitive.

In the group of 14 radioresistant tumors adequate data exist with respect to the biological response to irradiation in 13. Following irradiation, 5 remained alive without evidence of disease for periods of from one to three years, while 8 succumbed in the same time. Among the 8 patients who died there was either no decrease in the excretion of prolan A in response to irradiation, or only a temporary and incomplete decrease, followed almost immediately by an increase in the excretion of prolan A to the initial level which obtained before irradiation, or higher.

Of the 5 patients who remained alive and well with radioresistant tumors, irradiation produced a sharp drop in the excretion of prolan A to a level below 400 mouse units per liter of urine. In all but one of these the excretion of the hormone did not again increase. This case (Case 69) is of great interest. The patient was admitted as a postoperative prophylactic case, without clinical evidence of disease, one week after orchidectomy. The excretion of prolan A at this time was 10,000 mouse units per liter of urine. This finding prompted the immediate reclassification of the case



Influence of Local Recurrence and Metastasis on Excretion of Prolan A

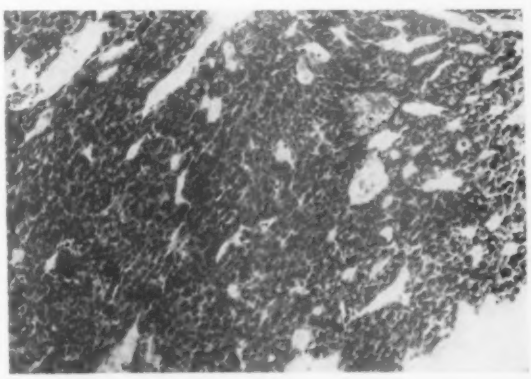
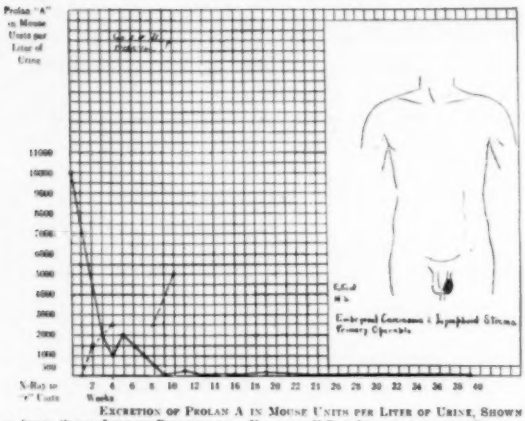


Fig. 1. Photomicrograph of primary tumor in Case 69 and chart showing behavior of prolan A in relation to treatment.



Excretion of Prolan A in Mouse Units per Liter of Urine, Shown in Solid Black Line in Relation to r Units of X-Ray Delivered to the Primary Tumor as Shown by Dotted Line

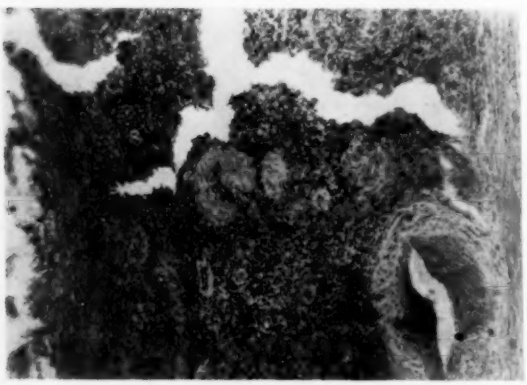


Fig. 2. Photomicrograph showing complete destruction of embryonal carcinoma of the testis by high voltage roentgen therapy. Tumor removed six weeks after irradiation. Chart illustrates behavior of prolan A in response to treatment.

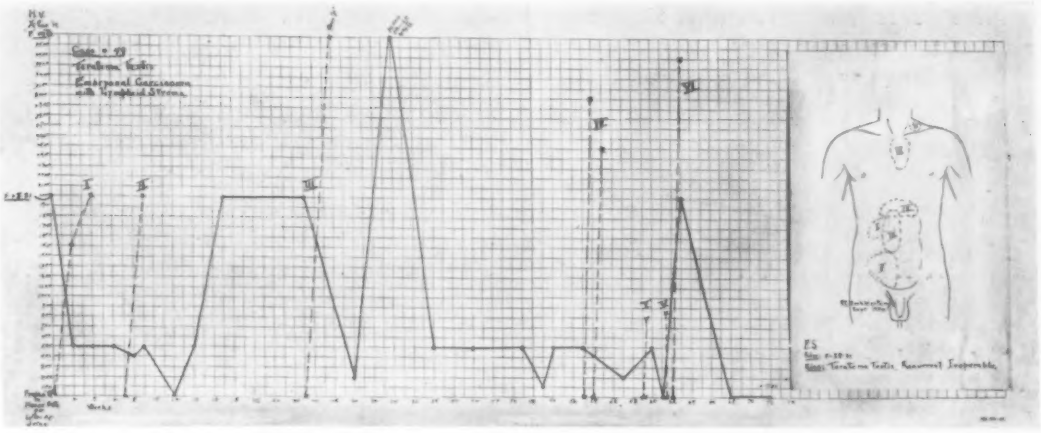
to the recurrent inoperable group. After prophylactic irradiation the hormone completely disappeared from the urine, but six weeks later again increased to 1000 units per liter. Careful examination at this time revealed no evidence of disease, but five weeks later a palpable mass was found in the left epigastrium. Further treatment directed at this area resulted in a prompt drop in the excretion of prolan A to 100 units per liter, where it has since remained. The patient is at the present time alive and well without evidence of disease one year and ten months after admission (Fig. 1).

Of the 22 patients with tumors classified as radiosensitive or relatively radiosensitive, 13 remained alive and well without evidence of disease for periods varying from one to three years, while 9 patients succumbed in the same time.

In the 13 survivors the excretion of prolan A promptly diminished to levels below 400 mouse units per liter of urine in response to irradiation (Fig. 2). This response was prompt in every instance and usually complete within two weeks after termination of the irradiation. There were two exceptions—in each of these there was a prompt decrease in the excretion of prolan A in response to the initial course of roentgen treatment, but one or more recurrences produced definite rises in the excretion level of the hormone. Prompt irradiation directed at these recurrences again reduced the excretion of prolan A below 400 mouse units per liter, where it has since remained in each case for more than one year (see Case 49, Fig. 3).

Nine patients succumbed with tumors classified as radiosensitive. Their high level of hormone excretion was unaffected except in one case. In this case there was a slight temporary reduction in the excretion of prolan A, with prompt recurrence to the initial level, and further irradiation had absolutely no effect upon this. It is true that in these 9 instances the mass of the disease present before irradiation was very great; all had metastases in the abdomen, while 4 had multiple metastatic deposits in abdomen, lungs and neck.

The examples above cited show that the biological response of the tumor to irradiation as measured quantitatively by the excretion of prolan A is of greater prognostic value than the histological description of radioresistance or radiosensitivity. Five cases classified as radioresistant are without evidence of disease after adequate treatment. Repeated assay of the urine in these cases shows a prompt and decisive response to treatment. The prognostic value of the assay becomes more apparent when one considers the 9 tumors classified as radiosensitive, in which there was failure to cure after irradiation. In these cases no



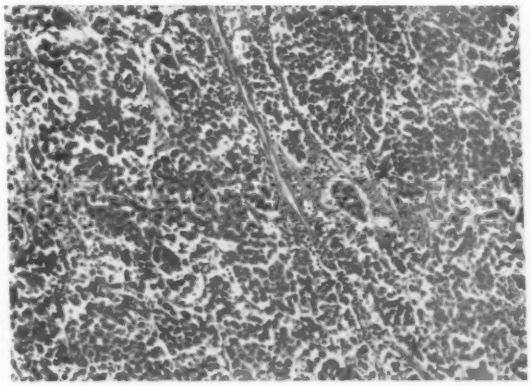


Fig. 3. Photomicrograph of primary tumor in Case 49 showing effect of multiple recurrences on the excretion of prolan A and the response to treatment.

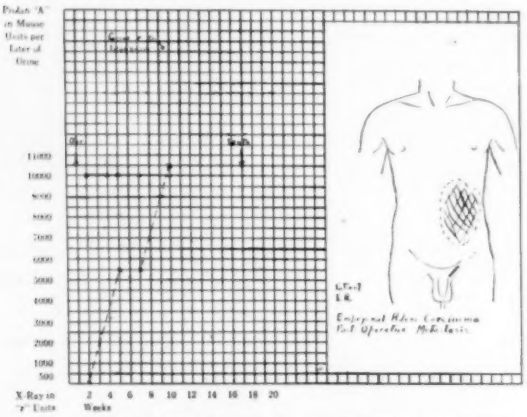
permanent effect was noted on the quantitative excretion of prolan A in the urine. Failure to achieve a decrease in the excretion of prolan A in the urine after adequate irradiation in either primary or metastatic cases is a fatal prognostic omen as observed in this series. The description of the radiosensitivity of the tumor cannot take into account the extent of the disease or the actual response to treatment. The hormone test indexes both of these factors with a high degree of prognostic accuracy (Fig. 4.)

These observations might be unimportant except for the fact that the histological structure of the tumor and the interpretation of its radioresistance or sensitivity have been widely heralded as a basis for the selection of therapy as between irradiation and radical surgery. Among the exponents of radical surgery, Chevassu and Hinman admit the radiosensitivity of the so-called seminoma and advise the use of irradiation in such cases when the condition is inoperable, and as a postoperative measure in operable cases. At the same time, the value of irradiation is denied by them in other structural types of teratoma. Others, like Wasterlain, who evaluate the criteria for the selection of treatment from broader points of view, emphasize the radiosensitivity of the so-called seminoma, but appear to be unaware of the very real radiosensitivity of other teratomata.

Further evidence of the true radiosensitivity of the several types of teratoid tumors is gleaned from a study of the successes and failures in a series of 154 cases treated more than five years ago by Barringer, Dean, Janeway, Coley and Quick at the Memorial Hospital. All of these patients were treated before biological assay of the urine for prolan A was available. The results, however, correspond closely with the evidence above cited. Of these 154 cases treated prior to October 1, 1928, sections of the primary tumor are available for review in 40 instances. Twenty-two of the patients represented by these sections are alive and well without evidence of disease for more than five years, while 18 either died or were lost to record in less than five years.

Of the 22 patients alive and well more

than five years, 7 were found to have radioresistant tumors. Thirteen tumors were interpreted by independent observers as being radiosensitive, while it was impossible



Failure of X-Ray to Influence Excretion of Prolan A in the Urine; Fatal Prognosis

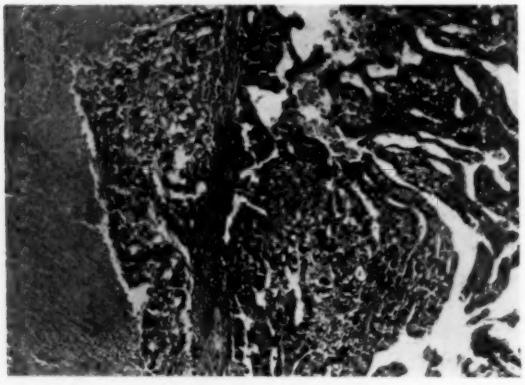


Fig. 4. Photomicrograph of primary tumor and chart illustrating behavior of prolan A in the urine in a case which is both biologically and histologically radioresistant.

to classify 2 on account of the radiation changes produced in the primary tumor by prior treatment. These 2 cases should, of course, be included with the radiosensitive group, making 15 in all.

Of the 18 patients dying, or lost track of, from whom sections of the primary tumor are available for review, 9 were interpreted as radioresistant and 9 as radiosensitive. Hence, of 18 patients with tumors classified as radioresistant, 7 are alive and without evidence of disease for more than five years. The prognostic value of the diagnosis of radiosensitivity in this group then is but 56 per cent efficient. Of 22 cases classified as radiosensitive, 9 failed to survive five years, which would place the prognostic value of the determination at 59 per cent. In summary, therefore, the histological determination of radiosensitivity in a series of 40 cases of teratomata treated more than five years ago corresponded with the outcome at the end of five years in only 21 of the 40 cases, or 52.5 per cent.

It is worth while to examine the radioresistant tumors in the five year group as to structural type and the distribution of the disease at the time irradiation was begun and to compare this with the three year group already cited. Of the latter there were 5 cases alive and well from one to three years. In 2 instances the tumor was an adult type of teratoma and in 3 embryonal adenocarcinoma existed. In 2 of the latter there were bulky abdominal metastases.

In the five year group the clinical status at the time of admission was as follows: 4 cases were admitted with primary operable tumors without evidence of metastasis; one was a primary inoperable case with bulky metastasis in the abdomen; one was admitted with a small recurrent tumor in the groin after orchidectomy, while the seventh case was admitted to the postoperative prophylactic group shortly after orchidectomy. Of the 7 tumors, 4 were classified as embryonal adenocarcinoma of teratoid origin; the remaining 3 were adult types of teratoma. This evidence shows conclusively that the embryonal adenocarcinoma of teratoid origin, generally regarded as radioresistant and highly malignant, will yield in some instances to adequate and thorough irradiation, as is shown in 5 cases in this series. In 3 of the 5 cases there were metastatic deposits in the abdomen which yielded to treatment and the patients are now alive and well with complete regression of these previously palpable masses. Of the 3 cases of adult teratoma in the group of five year survivors,

one, admitted as a postoperative prophylactic case without evidence of disease, later developed a metastasis in the abdomen which yielded to adequate roentgen therapy. The adult teratoma is quite generally regarded as the most radioresistant of the entire group and yet here is one instance, at least, where this very radioresistant tumor was cured by irradiation. This patient is alive five years and eleven months after treatment, with no present evidence of disease.

Ewing, in 1928, made the following statement:

> In recent years it has become apparent that the study of radiosensitivity may be carried very much farther than at first seemed possible; that there are important variations in this property in the subgroups of the major forms of cancer; that the factors entering into radiosensitivity are very numerous and sometimes rather obscure; . . . and that all these matters require careful evaluation before radiation therapy can be intelligently conducted, and its results predicted.

These statements are supported by the evidence cited, which shows that for the group of testicular teratomata there are important variations in radiosensitivity which cannot as yet be rightfully evaluated on histological grounds alone and, further, that the combined study of the structural features of the tumor and its biological behavior as evidenced by the quantitative excretion of prolan A is of greater prognostic importance and a better indicator of true radiosensitivity than histological evidence alone.

PATHOGENESIS AND PATHOLOGICAL ANATOMY OF TERATOMA TESTIS AS A BASIS FOR THE SELECTION OF THERAPY

The selection of the proper treatment for any of the major forms of cancer must rest on an accurate understanding of the life history and pathological anatomy of the disease. If the facts with regard to the pathogenesis of teratoma testis were familiar to all, the rationale of radical surgery would be entirely discredited.

A clear anatomical exposition of the normal lymphatic apparatus draining the testis is not to be found by consulting descriptions given by the proponents of radical surgery. These descriptions generally terminate with the nodes about the pedicle of the kidney. Cuneo is speciously quoted as authority for the statement that the lymphatics of the testis empty into the lumbar lymph nodes up to the level of the renal vessels. However, the same student of the anatomy of the lymphatics has shown that in 90 per cent of normal individuals at least one lymph channel can be demonstrated ascending above the renal vessels and connecting with the mediastinal chain of nodes. It is not necessary to pursue the study of the normal lymphatic drainage of the testis further, as clinical and pathological evidence abounds on this point.

A distinction must be made at once between the adult types of teratoma containing few epithelial elements and all other types which are basically embryonal carcinomas. The adult type of teratoma runs a prolonged clinical course. The tumor may exist quiescent for years and then become active, with local extension and invasion of the nearby spermatic and lumbar lymphatics. Distant metastases are rare and usually occur late in the disease. This group of tumors, however, constitutes a small percentage of teratomata (variously estimated from 5 to 10 per cent) and accounts for many of the reported cures by simple orchidectomy and by radical surgery. Since its life history is so long, the tumor is often removed before local extension or distant metastasis occurs, and on the whole the tumor is not to be regarded either on histological or clinical grounds as highly malignant.

Of the 77 tumors here reviewed, 5 were of this type. Only one patient presented clinical evidence of lymphatic extension and this involved the proximal lymph nodes in the lower abdomen. In reviewing

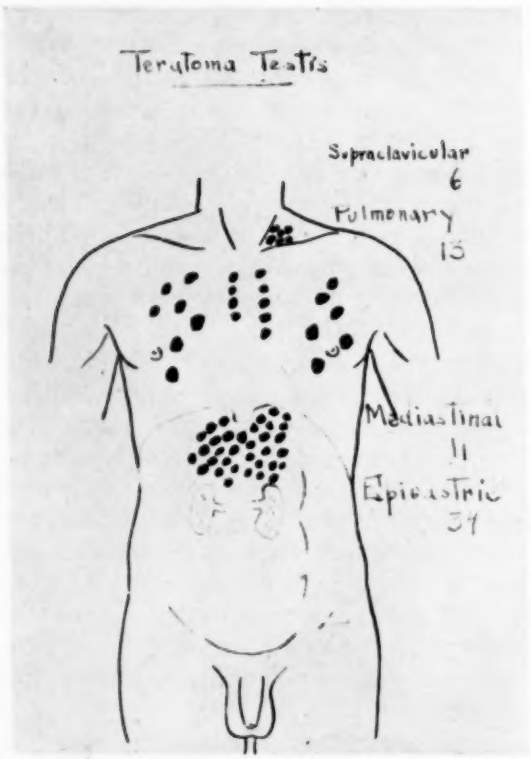


Fig. 5. Diagram to show the distribution of inoperable metastases in a series of 45 cases.

the sections of the adult types of teratoma in this series no instance of invasion of the small blood vessels was found and there were no pulmonary metastases in this group.

The life history of the various types of embryonal carcinoma of the testis is an entirely different matter. The disease apparently arises from an embryonal rest in the rete testis (Ewing), suddenly becomes active, invades the lymphatics and veins, distributing the disease rapidly to the lumbar, epigastric, mediastinal and cervical lymph nodes, and, through the venous circulation, to the lungs. One should deal with a suspected tumefaction of the testis with embryonal carcinoma in mind, rather than planning therapy for the 10 per cent of adult teratomata.

Seventy-two of the 77 tumors reviewed were classified as embryonal carcinomata as opposed to 5 adult teratomata. Forty-five of the 72 cases had demonstrable metastases either on admission or in course of treatment, which were beyond the scope of radical surgery. (On this basis all involvement below the level of the renal pedicle is excluded. Only epigastric, mediastinal, pulmonary and supraclavicular metastases are included.) (Fig. 5.) The tumor was distributed through lymphatic channels to the epigastric lymph nodes 34 times, to the mediastinal lymph nodes 9 times, and to the supraclavicular lymph nodes 6 times in these 45 cases. There were 13 instances of demonstrable extensions of the tumor to the parenchyma of the lung through venous channels. Of these 45 cases with metastases beyond the scope of radical surgery, 23 are drawn from the five year group and 22 from the three year group. Five patients with such metastases are alive and well without evidence of disease more than five years. Four patients are alive and without evidence of disease from one to three years. The excretion of prolan A in these 9 patients on repeated observation is continuously below 400 mouse units per liter of urine.

Further evidence of the natural progress of the disease is afforded by Hinman's most recent paper on the end-results of radical operation for teratoma testis. In Hinman's Table IV containing 38 collected cases subjected to radical operation by various surgeons, metastases were found in the lymph nodes in 34. Twenty-two of these patients are listed as dead, the cause of death being stated as due to metastasis in 16 instances. The location of these metastases is specified in only 9 cases. There were demonstrable metastases in the lung in 6 cases, once in the spinal cord, once in the cervical lymph nodes. Two patients died with metastases in the liver and in one the location was specified as abdomen.

It is safe to assume that all of the metastases here reported are beyond the scope of radical surgery on account of the inaccessible location of the involvement.

Sufficient evidence has been adduced to show that the natural history of the embryonal forms of teratoma consists in a pro-

gressive involvement of the normal lymphatic apparatus of the testis, which on anatomical, pathological, and clinical grounds, includes the spermatic, lumbar, epigastric, mediastinal and supraclavicular lymph nodes; and further that the disease extends through venous channels to the parenchyma of the lung in a formidable number of cases. It is demonstrated that 9 patients with metastatic involvement beyond the scope of radical surgery were cured by irradiation and that no patient in Hinman's series with metastases above the level of the renal pedicle is cured. It is obvious that the radical operation disregards the normal pathogenesis of the disease and is based on false premises. It should be entirely discarded.

TREATMENT

That no justification for the selection of either simple orchidectomy or the radical operation of Chevassu-Hinman exists on the basis of clinical results at the end of five years is shown by the most recent statistics of Hinman and by the very capable review of Wasterlain.

Wasterlain came to the conclusion, after a careful review of the reported results at the end of four years following simple orchidectomy, that less than 6 per cent survived. This corresponds for all practical purposes with the incidence of the adult types of teratoma.

As to the radical operation, Wasterlain canvassed the European field and states that in France the results at the end of four years do not justify the original theoretical promise of the operation. The recent opinion of Grégoire, who did the first radical operation on April 20, 1905, is quoted by Wasterlain. Grégoire states that 12 of his original 13 patients succumbed between two and twenty-four months following operation. The only survivor is still living after nineteen years, but Grégoire points out that no metastatic lymph nodes were demonstrated in this case and he concludes that a simple castration might have produced the same result.

Exclusive of Hinman's recent report, there are no statistics in the literature on the five year results after radical operation for teratoma testis. With the exception of single case reports, this material is so scarce that Wasterlain had to base his review on three and four year end-results. Hinman is able to show that of 100 cases in which the radical operation for teratoma testis was performed by American surgeons, 17 are alive and without evidence of disease after five years.

Irradiation. It remains to be shown that the five year results of treatment by irradiation surpass the 17 per cent of cures reported by Hinman. Dean, in an analysis of the results of the treatment of 154 cases admitted to Memorial Hospital prior to October 1, 1928, has shown that 44, or 29.2 per cent, of this unselected group of patients remained alive and without evidence of disease at the end of five years.[6] It is worth noting that these results were obtained in a group of teratomata of which 115, or 74.6 per cent, were inoperable on admission. The diagnosis in each of the 44 cured cases was verified by pathological examination by competent pathologists with but 3 exceptions. In these 3 cases the presence of demonstrable metastases and the clinical course left no doubt as to the diagnosis. The primary tumor in these 3 instances was never removed.

The splendid results obtained by Barringer and Dean in this group of 154 unselected cases clearly establishes the superiority of irradiation as the treatment of choice for teratoma testis. As previously shown, this treatment is indicated in all cases whether the tumor be regarded as radioresistant or not.

That these results may be improved is shown by the status of these 154 patients at the end of one year and at the end of three years as compared with a current group of 59 patients observed from one to three years, in which observation and treatment have been controlled by repeated quantitative assay of the urine for prolan

A. The results are clearly indicated in Tables II and III.

From this tabulation it will be seen that the results in cases controlled by quantitative assay of the urine for prolan A after one to three years' observation clearly exceed the results in the older group as observed for only one year—52.6 per cent as opposed to 44.8 per cent. At the end of three years only 32.5 per cent of the older group were alive and it was not definitely known which of these living patients had residual disease and which did not. Of the 31 living patients in the group controlled by biological assay of the urine, 29 are without clinical evidence of disease and with a hormone output consistent with clinical cure. This is reassuring evidence that there will be fewer losses from this group on account of recurrent or metastatic disease. Should recurrence take place its presence will be promptly detected by an increase in the excretion of prolan A, usually before the mass becomes clinically evident. It is freely granted that much of the improvement in results is due to improved technique of irradiation. Yet it can hardly be denied that the prompt detection of recurrence and metastasis before clinical evidence supervenes and an exact knowledge of the biological response of the tumor to irradiation, as measured by the quantitative excretion of prolan A in the urine, have been important factors in the results obtained.

TABLE II

STATUS OF 154 CASES OF TERATOMA TESTIS ADMITTED BEFORE OCTOBER 1, 1928, AT THE END OF ONE YEAR AND THREE YEARS

	Alive with or without Evidence of Disease	Lost to Record	Dead	Total	Percentage Alive
End of one year	69	30	55	154	44.8
End of three years	50	30	74	154	32.5

TABLE III

STATUS OF 59 CASES ADMITTED FROM OCTOBER 1, 1930, TO OCTOBER 1, 1932, AS OF OCTOBER 1, 1933

Treatment and Observation Controlled by Repeated Quantitative Assay of the Urine for Prolan A.

Clinical Classification	Alive without Evidence of Disease. Prolan A less than 400 Mouse Units per Liter of Urine	Alive with Recurrence. Prolan A above 400 Mouse Units per Liter of Urine	Lost to Record	Dead	Total	Percentage Alive—One to Three Years
Primary operable	4			3	7	
Primary inoperable	1	1		2	4	
Recurrent operable	4		1		5	
Recurrent inoperable	9	1	3	18	31	
Prophylactic	11			1	12	
	29	2	4	24	59	52.6

SUMMARY

1. The use of the quantitative estimation of prolan A in the urine in the diagnosis of suspected cases of teratoma testis and the classification of the disease on biological grounds is recommended.

2. The diagnosis of radioresistance on histological grounds is not a safe criterion on which to select treatment. It is demonstrated that the biological response of the tumor to the therapeutic test of irradiation

is the only safe criterion of radiosensitivity and is at the same time an accurate prognostic index.

3. The pathogenesis and pathological anatomy of teratoma testis contraindicate the selection of either simple orchidectomy or the radical operation of Chevassu-Hinman as efficient forms of treatment.

4. The results of treatment by irradiation in a series of 154 unselected cases is shown to be clearly superior to the results obtained by radical surgery—29.2 per cent as opposed to 17 per cent (Hinman).

5. It is demonstrated that the results obtained by irradiation have been definitely improved by the adoption of routine biological assay of the urine for prolan A.

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MANAGEMENT OF CANCER OF THE MOUTH AND THE CERVICAL LYMPHATICS*

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A CONSIDERATION of the treatment of intraoral cancer must embrace two distinct, although not separate, problems—the primary growth, and the most usual paths of metastatic dissemination. There is a tendency toward undue prominence, in a relative way, of technical details of primary growth treatment, in radiological literature. Associated factors in the care of the primary tumor and a definite plan for dealing with metastatic extensions to the neck are apt to be given slight consideration.

It is the purpose of this paper to stress these latter points. In former publications, my methods of primary growth treatment have been set forth in detail. They will be reviewed here only briefly and for purposes of continuity.

The term, intraoral cancer, is assumed to include, clinically, epidermoid carcinoma of the oral mucosa, plus that of the maxillary antrum and structures of the tonsillar fossa. Growths of the nasal accessory sinuses, nasopharynx and hypopharynx are not included in this discussion. Anatomical and particularly histological considerations place them in a different clinical group, although many factors of cervical node metastases are common to both groups. Growths about the tonsillar fossa might well be claimed by either clinical group.

TREATMENT OF PRIMARY TUMOR

External Irradiation. In my opinion and experience, external irradiation at distance occupies the leading position and represents the first step in treatment of every case of intraoral cancer that is at all acceptable for treatment. For many years remarkable results have been noted in occasional cases from external therapy. We now know the reason for this: it was not due to the intensity of the treatment. The growth was an undifferentiated tumor and hence particularly radiosensitive. Such experiences, however, coupled with careful histological studies of the tissues from such growths, have paved the way for the reasonably and progressively efficient external therapy of the past few years. With improved therapeutic equipment and the accumulated experience in histological interpretation, plus reasonable accuracy in the calculation of tissue dosages, it is now possible to deliver an intelligent and effective dose from an external source of radiation.

A very few of the primary growths, from the group under consideration, may yield completely to this form of treatment alone. Usually, however, substantial but partial regression is all that is expected. Such aid permits of finishing the treatment with interstitial irradiation of lesser intensity, with greater accuracy, greater safety and less danger of secondary necrosis.

When we compare this advance with the empiric and inefficient external therapy of even ten years ago, it indicates something of the possibilities which the future holds for external irradiation. The surface has scarcely been scratched. No single factor, in what is today regarded as an efficient modern therapy set-up, can be accepted as the ideal. We know from experience that clinical results have steadily improved with the administration of greater quantities of radiation of shorter wave length. The timing, quantity, and periodicity of the individual exposures making up the total dose are far from settled. The clinical effects are not entirely in keeping with physical laws. There comes a point beyond which clinical effects and biological reactions diverge from that which might be

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expected from physical calculations. Improvement in the radiation therapy of intraoral cancer lies chiefly in the gradual working out of these various factors. External irradiation is coming all the while to occupy a more prominent position in this phase of the work.

Roentgen radiation is the only practical source of this external radiation. Radium, in sufficient quantity, serves as an excellent experimental guide and stimulus toward improvement in roentgen therapy. Beyond this it is not feasible from an economical standpoint and its use for external irradiation, in the manner usually employed, is to be deplored.

Surface Irradiation. In the treatment of intraoral cancer, surface or contact applications of radium, no matter how heavily filtered, have no place. In a very few instances, and particularly with the lip, applications may be made to advantage with an intervening distance of 1 or 2 centimeters. Even in these there is an element of needless uncertainty which could be avoided by resort to interstitial therapy. The usual surface application is not sound from a physical standpoint. The ratio between undesirable surface effect and therapeutic effect at depth is such that a lethal tumor dose may mean gross permanent damage to the surface. Radium burn scars are unstable and painful. Blood supply to the surface epithelium is interfered with directly as well as by the fibrosis underlying the scar. Sensory nerve fibrils caught in the zone of fibrosis are extremely hypersensitive.

Interstitial Irradiation. A high percentage of primary growths, of the group under discussion, are dependent for completion of their therapy (after thorough external irradiation) upon interstitial implantation in some form. A good many oral growths are technically amenable to the implantation of needles containing either element or emanation, preferably the former. Some operators prefer them because of the extra filtration and avoidance of a permanent foreign body. Others, with a very limited radium supply, use them from necessity. Whatever the technical method of implantation, accuracy of placement, adequate intensity of dosage, and avoidance of undue trauma, are the important factors.

In my experience, radon seeds, as permanent implants, represent the most efficient means of interstitial irradiation. The unfiltered glass seeds used from 1916 to 1925 salvaged more cancer cases than any method of irradiation of that period, even though at the expense of tremendous suffering, particularly from necrosis. Since Failla was able in 1925 to seal emanation in gold capillary tubes, most of the objections to "seeds" have been overcome. Within proper, and at the same time adequate, dosage limits, necrosis is rare. Improvement in external therapy has lessened the necessary intensity from implantation. Pain is less for these reasons, as well as by virtue of the difference in quality of the radiation itself. The 0.3 mm. gold filter of the tube wall cuts out most of the softer gamma radiation and hence permits of using much greater quantity of more desirable quality of radiation, within the limits of tissue tolerance.

The wide technical range of adaptability of the gold seed appeals strongly when one is faced with the actual problem of treating the individual case. The technical flexibility of such a method permits of an accurate distribution not possible with the larger needles, in most instances. The ultimate foreign body problem has proved by experience to be theoretical rather than real. Trauma is infinitely less than with needles in place from one to several days. As for metal-jacketed removable glass radon seeds on a string, there is no comparison of their general efficiency with either of the previously mentioned methods. The gold seeds sacrifice something in filter, compared with the usual type of element needles, for their other advantages.

The gold seeds as permanent implants offer another advantage in that adjacent parts in the anterior portion of the mouth can be protected from unnecessary and

damaging radiation. Dental appliances of vulcanite, with or without lead inlay, are not difficult to make to suit the needs of the individual case. They are a remarkable protection to adjacent normal mucosa and need only be worn for a fortnight—the period of practical radon activity. Patients frequently cling to them longer because of the protection they afford from swollen tissues over-riding the teeth.

Influence of Tumor Histology. In one sense, the influence of histology on therapy is not as great within the mouth proper as in growths of the nasopharynx or hypopharynx. The tonsillar group is the only exception, and as was pointed out, this group is anatomically borderline between mouth and pharynx. Relatively few of the intraoral growths are anaplastic. Grade III and IV tumors, except in the tonsil, are rare in this general group. However, radiosensitivity and grading are not exactly parallel. Grade II, or even Grade I, epidermoid carcinomata may be relatively radiosensitive by reason of their vascular apparatus even though the tumor cells are fully differentiated, or nearly so. An infected anaplastic tumor may be more radioresistant than a surgically clean Grade I growth. A fully differentiated growth in an otherwise normal tongue varies considerably in radiosensitivity from another fully differentiated growth in a luetic tongue by reason of the fibrosis and altered capillary blood supply, the result of the luetic glossitis.

It is evident, therefore, that even within the narrow gradation limits of intraoral cancer, the histologic picture has a practical guiding influence on treatment intensity. Furthermore, it points out those growths more liable to widespread dissemination, a factor which will be referred to again in considering cervical metastases.

With the tonsillar group, the influence on therapeutic procedure goes much further. Many of the growths are anaplastic, and in these, external irradiation only is indicated. The secondary factors influencing the "radiosensitivity grading" in contradistinction to strictly "cellular grading" will decide whether moderate or interstitial irradiation is called for in those growths arising previously in tonsillar epithelium.

Caution should be exercised in deciding the anatomic origin of growths about the tonsillar fossa. The base of the anterior tonsillar pillar, on the lingual side, is a favorite site of origin for cancer. Growths arising in this location are prone to invade the tonsillar fossa, yet they do not assume, in so doing, the radiosensitive characteristics of cancer arising in epithelium of the tonsil—the lympho-epithelium of Schmincke and Regaud. On the lateral border of the tongue, and immediately adjacent to the base of the anterior tonsillar pillar, where it fans out in its lingual attachment, there is a patch of lymphoid tissue covered by this peculiar epithelium. It is a fairly common site of growth origin and is very close to the common tonsillar-pillar site. Furthermore, it is lateral-border-of-tongue cancer, and yet much more radiosensitive than the usual lateral border lingual epidermoid.

Biopsy and the microscope, in the hands of an expert tumor pathologist, are essential and integral parts of radiation therapy within the mouth, as elsewhere.

Oral Hygiene. Within the past few years, intraoral radiation therapy has advanced from empiricism to a procedure of reasonable accuracy. External irradiation is on the threshold of real efficiency. Tissue dosage by implantation can be estimated by physical means and this in turn is correlated and guided by histological interpretation of the relative radiosensitivity. The technical facilities for implantation are much improved. And yet, all of this work goes for naught in a large percentage of cases if proper attention is not given to the establishment of rigid oral hygienic measures prior to and concurrent with treatment. Rough, ragged, irregular and neglected teeth, as well as ill-fitting dentures, are a problem of cancer prevention. They may aggravate local conditions in the course of cancer treatment but their es-

sential damage has already been done. The infection which they harbor and the chronic inflammatory changes in adjacent soft parts, which they perpetuate however, are a menace to successful cancer therapy which cannot be overestimated.

The question of whether or not to extract offending teeth prior to the initiation of treatment is frequently raised. It is one which must be settled on the status of the individual case. The complementary damage in causing the growth is past. The opening up of fresh tooth sockets, in the presence of both uncontrolled cancer and infection, is poor surgical practice, as well as dangerous from the standpoint of secondary invasion of bone by tumor implants. However, the mouth infection must be under control before success from irradiation can be anticipated; if radical exodontia is necessary to accomplish this, it should be resorted to at once.

Few cases of mouth cancer, even though early, can be successfully handled by any means in the presence of uncontrolled oral infection. The danger extends far beyond the local field within the mouth. Active mouth infection means a generalized cervical adenitis of varying degree. With the resistance of a lymph node lowered by infection, it is readily conceivable that a tumor embolus is more likely to grow if implanted at that stage. Furthermore, a normal response to irradiation of the neck cannot be expected in the presence of such an adenitis.

If it is necessary to hospitalize the patient in order to manage the oral hygiene, it should be done. Hospitalization, however, is not enough. Special equipment and specially trained conscientious nurses are essential. Usually the situation can be handled in a well-equipped office, but it can rarely be done through the unaided efforts of the patient alone.

Irrigations at intervals of one or two hours with hot bicarbonate of soda, or hypertonic saline, are of inestimable value. The former solution is suitable in the presence of excessive thick and tenacious mucus, but the latter is preferable if inflammatory swelling of the soft parts is to be dealt with. The quantity should be at least two quarts per irrigation. Free use of albolene following the irrigations will safeguard against irritation of the mucosa from frequent use of so much aqueous solution. Cleansing with sprays under pressure is essential and may well be alternated with the irrigations. Many alkaline solutions suitable for dissolving mucus are available. Peroxide of hydrogen is an effective oxidizing agent. Either peroxide or soap may be used for cleansing around teeth and over the dorsum of the tongue. Some of the non-irritating silver salts may be used to advantage on a fissured, ulcerating surface, which is heavily infected. Cocaine should never be used in the routine care of these cases. Butyn is sufficient and very satisfactory to carry over an extremely painful period. Bismuth (subcarbonate or subgallate) is of value for coating surfaces, as a deodorant, as well as for physical protection. A local cleansing treatment should always be finished by use of an oil spray or application. The normal mucus is altered in character, and though tenacious, is scanty. The oil is needed for lubrication. This is not meant to be a formulary but merely a group of suggestions to aid in making the technical and specific therapy successful. Cancer cannot be treated successfully in the presence of unbridled infection.

Another simple, yet important and frequently neglected, problem is the feeding of the patient during the active treatment period. The diet should be ample in calories and above the patient's normal caloric intake. It should be well balanced and acceptable in consistency. Fluid intake should be forced to the limit. With the more extensive growths it is often difficult or impossible to meet these conditions during the acute phase of reaction to radiation. Furthermore, the local cleansing is complicated by a food intake rich in milk products. Under these circumstances a post-nasal feeding tube is a blessing indeed to

both patient and nurse. The food and caloric intake is then managed simply. Fruit juices may be given at will. Medication may be given through the same channel. Much pain is quite naturally obviated. Local infection is more easily handled. There is less fatigue and more rest for the patient.

In addition to the local and immediate problems attendant upon the mouth itself, we must not lose sight of the general medical condition of the patient. The average intraoral case is in the degenerative period of life. The cancer phase must not be allowed to entirely overshadow the chronic constitutional diseases which may be in the background. Above all, anemia must be avoided or corrected. Liver extract and iron find a large field in the general therapy of cancer.

Syphilis as a Complicating Factor. The problem of tertiary syphilis as a complication is met with frequently in dealing with cancer of the mouth. In differential diagnosis, the positive Wassermann reaction is as much a curse to the cancer patient as it is a boon to the luetic. There is no reason why the two diseases may not actively coexist; they frequently do. A biopsy avoids neglect of the cancer. In therapy, rather too much importance is placed on an associated leucoplakia of demonstrable luetic origin. There is an exception to this. Cancer of the tongue arising in an area of luetic leucoplakia almost invariably has an underlying luetic glossitis as a tumor bed. Tongue muscle so altered does not react normally to irradiation, nor does it withstand heavy irradiation well. It is prone to break down, and hence cautery removal, after irradiation, of any questionable area is indicated more freely and at an earlier date than in an otherwise normal tongue. Antiluetic treatment concurrent with irradiation is not contraindicated as has often been suggested. It is a distinct advantage and a stimulant to healing. It should, however, be of moderate intensity and, in my opinion, limited to mercury and iodides. The patient's strength is heavily taxed by "anticancer" therapy and hence is not equal to the type of antiluetic therapy which would meet with the full approval of the syphilologist. After the growth is under control the other treatment, if indicated, may be pushed more vigorously.

Indications for Surgery within the Mouth. In my opinion, operative surgery has no place within the mouth for the direct treatment of cancer. Responsibility for control of growth should be vested in radiation. In order that irradiation may be technically facilitated, and for certain definite associated complications, operative measures are indicated. For these, the cautery methods are preferable where feasible. The high-frequency bipolar cautery affords greater adaptability than the older thermo-electric instruments.

(*a*) Access to Tumor-Bearing Area. Growths in certain locations, particularly in the maxillary antrum, are not sufficiently accessible to treat by implantation with any degree of accuracy. It is a simple matter to remove the anterior wall of the antrum, or anterior wall and adjacent alveolar process, if the bone is secondarily invaded. This not only provides direct access to the growth but affords drainage as well, and facilitates subsequent cleansing.

(*b*) Drainage. An example of the need for drainage has just been given in the opening of the most dependent portion of the antrum. Such a defect is readily closed by a denture after healing has been completed. Direct and permanent access is necessary for proper observation of the questionable area. If infection has extended to such depth in tongue or floor of mouth as to result in central abscess, removal of as large a segment of the condemned tissue as possible, by cautery, is indicated, to provide drainage and subsequent local cleansing. If possible, implantation of radon should precede the partial removal of such a growth. It is safer from the standpoint of tumor dissemination, but there is a still more important reason. Wherever an area of tumor tissue, condemned to removal, can be utilized as a

radon holder it should be so taken advantage of. The time interval between the implantation and the subsequent cautery removal may be shortened if necessary—but not preferably—by the implantation of an "overdose" of radon and then doing the removal at the time when sufficient of the radon has been used up. The surface of such a wound will show a normal radiation exudate or surface reaction some days later, and at the same time as it would have become manifest grossly had no cautery operation been interposed. Too much valuable time is lost by first operating on such an area and then implanting the remaining base of tumor tissue.

With certain of the extensive growths centered about the lower pole of tonsil, it is practically impossible to gain access to the pharynx and hypopharynx for cleansing and drainage of the inflammatory exudates. Cautery removal of the bulk of tumor tissue, after implantation, in such fashion that the trough of the floor of the mouth is extended backward into the hypopharynx, facilitates tremendously the handling of the surgical case. It affords free access and permits of space for all the necessary cleansing procedures and irrigations.

(*c*) Invasion of Bone by Tumor. With the increasing efficiency of irradiation, it is possible to destroy epidermoid carcinoma which has secondarily invaded bone underlying the soft-part structures of the mouth. However, such control of growth is by no means sure and, furthermore, a serious surgical complication—osteomyelitis—remains to be cared for. A great deal of needless suffering, and a variable hazard of remaining tumor, will be avoided if the bone is removed surgically after the heavy combined external and interstitial irradiation is completed. In most instances the removal can be accomplished through the mouth rather than by the more disfiguring external operation. Final healing is much more prompt than if the bone is left to separate finally by sequestration.

(*d*) Extensive Post-irradiation Fibrosis and Secondary Necrosis. Even though it is possible to eradicate the growth within the mouth by irradiation, there are at times resulting scars which are hazardous or unsatisfactory. For instance, the radiation scar following successful treatment of carcinoma in a luetic tongue is much more liable to secondary necrosis, under the stimulus of some slight injury, than a similar scar in an otherwise normal tongue. For safety, it is much better to remove such a questionable area before necrosis occurs. The same is true where secondary breaking down is threatened or occurs under any circumstances. The procedure is not severe, the final scar is more flexible and contributes to a better ultimate result. With some very extensive growths, particularly in the anterior portion of the mouth, the scar following irradiation may be very dense. It may even result in undue deformity, especially if the tongue is involved. Here again, revision of the scar by a limited cautery procedure leaves a more comfortable and at the same time better functional result.

TREATMENT OF THE CERVICAL LYMPH NODES (METASTATIC OR UNINVOLVED)

This phase of the intraoral cancer problem is regarded differently in various circles. By those taking a strictly surgical view, neck dissection takes precedent in importance, and frequently in sequence, to treatment of the primary growth. It is not uncommon to see a patient, after an indifferent neck dissection, with an untreated primary growth of such extent that little hope can be offered by any means of therapy. On the other hand, many doing radiation therapy are apt to give all attention to treatment of the primary tumor with but little consideration for the neck problem, until confronted by a sizable metastatic node.

Recognition of the common avenues of dissemination is the least that can be expected by anyone assuming the responsibility for treatment of a case of cancer of the mouth. Whether the plan for meeting

the problem be surgical or otherwise, at least a definite plan should be a part of the surgical therapeutic formula. The entire problem is too serious to be handled in a symptomatic manner.

An acquaintance with the natural history of the various growths within the mouth readily indicates the common paths of dissemination. Growths of the lip, tip of tongue, and extreme anterior floor of mouth usually metastasize to the submental and submaxillary group nodes of the same side as the primary tumor. Growths farther back extend to the upper deep cervical group nodes. The node overlying and just posterior to the carotid bulb is involved by metastatic emboli at least three times as frequently as any other in the neck. A glance, however, at any one of the many excellent references on the distribution and intercommunication of cervical lymphatics will show how easily the "normal" manner of extension may vary. A metastatic embolus from any growth within the mouth is capable of extending to practically any lymph node within the neck. This must be kept in mind in planning to meet the individual problem.

Dissection en Bloc. It was just this circumstance which was fully and keenly appreciated by Crile when he advanced the theory and outlined the method for a much more radical extirpation of cervical lymphatics along with the removal of the primary growth. We must remember that this surgical advance was made prior to the era of radiation therapy. It represented an improvement in results even though the operative mortality was increased by the more extensive operation. Surgery was then the only recourse. Certain disadvantages were recognized then; others have come to light since. Yet even those who do not adhere to the theory and practice of routine en bloc dissection must pay tribute to it as a major advance in the treatment of mouth cancer for the period in which it was initiated. One of the sad facts attendant upon the procedure is that while many surgeons have talked in terms of the classic operation, few have actually practiced it.

With radiation therapy coming to occupy a stronger and more practical position in the treatment of this group of diseases, it is but reasonable to question the advisability of continuing with the classic neck operation as a routine procedure. The possibility of a greater service to a larger number of patients has been opened by modifying it.

Before going into the gradual trend of modification, I would like to point out some of the shortcomings of the routine en bloc dissection as applied to our present-day problems—but keeping in mind the fact that it was initiated before the radiation era.

One of the chief objections to routine neck dissection is that few of them in actual practice are more than local, or at best incomplete, operations. This is no fault of the classic method; however, it is an objection to the procedures which are cloaked under the guise of en bloc dissection.

When we look over the material coming to anyone doing a substantial amount of this work, we must be impressed by the high percentage of cases in which, for one reason or another, such an extensive operation is obviously not justifiable. The primary growth may be of such proportions that its control is very questionable and a radical neck procedure is not warranted. Secondary involvement of nodes may have extended beyond the node capsule or the metastatic process may be bilateral. When the disease has extended beyond the capsule of the node it is, with rare exceptions, beyond the scope of the most radical operation. The same is true of bilateral involvements even though the disease has not perforated the node capsules.

Age alone is not a contraindication to radical surgery, but the chronic and constitutional degenerative changes attendant upon advanced age are usually such as to preclude it. At least the immediate risk is much increased. Certain of the constitutional diseases, notably syphilis, demand caution in deciding upon extensive surgery,

even without the added factor of age.

The temperament of the patient, while not a serious factor in one sense, is nevertheless one which must be reckoned with. Some patients will discontinue treatment rather than submit to a hazardous and somewhat disfiguring operation when they can see no gross indication calling for it. There is no doubt that many patients avoid medical counsel far too long because of the fear of extensive and what they regard as mutilating surgery.

Since our knowledge of tumor histology has been fortified by the studies in grading and relative radiosensitivity, we have another very definite contraindication to extirpation of the lymphatics in certain of the otherwise technically operable cases. The nodes of anaplastic epidermoid carcinoma can be controlled, or destroyed completely, by external irradiation alone. The completely and partially undifferentiated growths follow a somewhat different course in their habits of dissemination. They certainly tend toward widespread distribution. Beyond this, they tend to multiple metastases early in their course, in contradistinction to the usual single node in the early stages of a fully differentiated epidermoid carcinoma. In this respect they approach more nearly the habits of some of the glandular types of cancer, notably the breast, where tumor emboli would seem to be shot off like showers of sparks. For many years it has been accepted, without too careful verification, that intraoral cancer is practically limited, in its secondary extensions, to the neck. It has been estimated that the incidence of involvement below the clavicle is less than 1 per cent. This figure was arrived at before cancer was studied in quite the intensive manner as at present. The figure for distant metastases is undoubtedly much higher. Furthermore, it is evident that the undifferentiated tumors account for the distant involvements. Hence, their radiosensitivity and their trend toward widespread metastases put them out of the class for radical neck surgery.

After we have taken account of all contraindications and frank objections to en bloc dissection—and in the light of our present advantages of added histological information and radiation therapy—it leaves but a small percentage, at best, of the rank and file of cases that might come under the heading of acceptability for the operation. To measure the cervical-node problem, therefore, with a surgical yardstick alone—operate on the technically operable, and relegate the remainder to whatever palliative therapy may be handy—is obviously unfair to the mass of material for which we are responsible in our daily work. Present-day needs demand a more comprehensive scheme which will embrace a larger percentage of the cases applying for treatment, and in the stage at which they apply. It is my opinion that present-day facilities afford a more comprehensive plan.

Conservative Treatment of Cervical Lymphatics. It is a pleasure indeed to give credit, for the plan to be outlined, to my former chief, the late Dr. H. H. Janeway.

The original premise was that the cervical lymph nodes, up to a certain point at least, performed a conservative function in the course of primary intraoral cancer. The well-established observation, that metastasis of this type of growth was by tumor-cell embolus rather than permeation of lymphatics, at once removed the practical necessity for extirpation of all tissues between primary growth and adjacent lymph nodes en masse and along with the primary growth. It was observed that many growths did not metastasize even in the very advanced stages; some not until they became very advanced. Of those that metastasized early and aggressively, the results of surgical dissection were very discouraging; as previously mentioned, we now know more about the majority making up this group.

Badly infected mouths were attended by earlier and more aggressive metastases. The results of dissection in these cases were even poorer in the group showing an associated gross inflammatory cervical aden-

itis. We know nothing of the number of tumor emboli which may be constantly discharged into the blood stream or lymphatics. If into the blood stream, they rarely survive so that here such dissemination is not a practical matter. It seems reasonable to assume that the lymph nodes must digest and reabsorb many tumor emboli and that only an occasional embolus gains foothold and grows within the node of lodgment. The observation of greater frequency of metastatic involvement in the presence of an inflammatory adenitis leads to the conclusion that tumor cells gain headway more readily in a lymph node of lowered local resistance. In fact, it is my opinion that a strictly normal cervical lymph node is capable of destroying regularly a tumor-cell embolus of epidermoid carcinoma, and that metastasis takes place only in a lymph node damaged by infection or of otherwise lowered resistance.

It was assumed that, if such be the case, it would be wiser to conserve the lymph nodes for their seeming appointed purpose and to enhance their normal function, so far as possible, by reducing the mouth infection through vigorous cleansing measures.

Observations of the recurrences in palpably uninvolved necks following radical dissection, and the absence of demonstrable tumor in many necks, considered to be grossly involved, are not flattering to the theory of routine en bloc dissection. It was our belief that as satisfactory and successful an operation could be done after a node became palpable as before. Furthermore, the palpable node afforded a certain central guiding point so that unwitting trauma at operation might be avoided. Such a liberty with the accepted theory quite naturally presupposed a careful routine follow-up of all cases in order that node enlargement might be promptly detected.

Coupled with this view of the strictly surgical side was our 1916 hope, rather than our 1933 realization, of real assistance through radium and roentgen rays. In the early years of the work, such cases as facilities permitted were irradiated through the side of probable involvement by a radium emanation pack filtered by 2 mm. lead, or the equivalent, containing 2,000 to 3,000 millicuries of radon, and at distances of 6 to 10 centimeters from the skin surface. The dose was the calculated "erythema" for the given distance; at that time erythema commanded an awesome respect. We know now, of course, that this quantity of radiation had but little direct inhibitory effect on tumor growth. What the effect may have been on the prospective tumor-embolus bed, as represented by the lymph node, is open to conjecture. It is not at all certain that the "indirect" effect of irradiation is to be reckoned on the same basis of calculation as employed in determining dosage intensities for established cancer grossly invading a node. The intense plasma-cell infiltration of a normal lymph node after even moderate irradiation is strongly suggestive of pronounced strengthening of the efficiency of the node as a tumor-embolus "filter."

Our earlier dissections embraced all of the cases deemed technically operable and without regard for infiltration of node capsule or bilateral involvement. Histological differentiation we did not recognize as of value. The palpably uninvolved necks we watched closely but refrained from dissection.

We made no distinction, in withholding dissections, between a papillary and an infiltrating type of growth, or between a low-rate metastasizing location such as the lip and a high-rate location such as the mucosa of the cheek. At that stage of the work (1916) this was undoubtedly an error.

Another error of that period was the lack of uniformity of our technical operation. Some were bilateral; some were limited to the submaxillary and upper deep cervical nodes; others to the upper and lower deep cervicals together with the posterior triangle. Some, and soon the majority, were complete, except for retention of the sternomastoid muscle. An effort was made to use radium within the wound in

each instance, either filtered tubes in rubber or glass radon seeds. The sternomastoid was retained for a time as a "holder" for the seeds. It hampered the dissection, particularly that of the posterior triangle. Later the operation became a standard complete unilateral procedure. That is, all structures from the submental group of the opposite side to the posterior triangle and including submaxillary salivary gland, internal jugular vein and sternocleidomastoid muscle, were removed in one mass. Radon was buried at suspicious points, until with the advent of more efficient external irradiation technique, it has not been strictly routine during very recent years. Local and conduction anesthesia has been a strong preference throughout; it obviates undue hurry, permits of cooperation on the part of the patient, calls for more delicate handling of tissue, and is attended by far less engorgement of vessels.

When gold filtered radon seeds (0.3 mm.) were available in 1925 the implantation problem was much improved and its scope widened. The experience of the previous years had gradually narrowed the anatomical limits of operations for extirpation of involved nodes. Observations on tumor grading and histological studies in relative radiosensitivity limited the radical operation still further. More accurate calculation on tissue dosages, necessary for complete control of certain types of epidermoid carcinoma, encouraged implantation to a greater degree. The rapid advances in external radiation therapy have still further encouraged the withdrawal of the radical operation in favor of the more conservative combined procedures.

The experience from 1916 to the present time may be classified to better advantage under the separate headings of factors of influence, setting forth the present position of each.

Neck Dissection. In my opinion, complete unilateral neck dissection occupies at present a definite, yet very limited, field in the care of intraoral cancer. It should be reserved for those cases of fully differentiated epidermoid carcinoma, in patients of good general physical condition, with primary growths controlled, or giving substantial promise of control, and in which the metastatic nodes are unilateral, palpable, and present clinical evidence of an intact capsule. Care should be taken to differentiate sharply, by clinical observation and examination, between inflammatory nodes, inflammatory areas in the submaxillary salivary gland simulating a node, and true metastatic nodes. Bilateral involvements and infiltration beyond the node capsule are distinct contraindications to radical dissection. It is true that cases well ten or more years may be shown (and can be shown by the writer) to refute this statement. One success, however, is no justification for several failures with any major surgical procedure, and particularly so where there is an alternative. One of the most depressing features of failure of radical dissection is that it usually leaves the patient worse off than had the operation not been done.

A review of my material, however, indicates clearly that within the limits outlined, and with but one exception, dissection should be the most radical possible, if done at all. Follow-up on the incomplete operations indicates much poorer results than with the simple unilateral dissection.

Lip cancer represents, in my material from private and hospital practice, the one exception. In this group, and here only, dissection limited to both submental groups, the submaxillary and upper deep cervical groups of the involved side, gave results equally as good as in those where the procedure was strictly complete.

Influence of Histology. In the neck, as in dealing with the primary growth, the histological picture is the outstanding guide to procedure. Complete differentiation may indicate dissection, following the external irradiation, if the other indications for dissection are fulfilled. The wholly anaplastic tumor is one for external irradiation only. The intermediate histological picture contraindicates surgery but calls for

implantation following external therapy.

Dosage Measurements. Calculations of dosages, particularly for implantation, and guided in intensity by the histological picture, are of relatively greater value in the neck than in the mouth. Metastatic nodes tend to be spherical, or at most ovoid, hence more compact for implantation. They are more accessible and their bulk can be estimated more accurately for total dose calculation. Experience, however, plays its usual part; the problem is not so much one of minimum tumor tolerance as it is one of the maximum amount that the surrounding normal structures will stand without permanent damage.

External Irradiation. What has already been said relative to external irradiation and the primary growth obtains with equal force in the problem of the neck. In most instances, the primary growth external therapy includes the cervical drainage area as well. If not, irradiation of the two should be carried on concurrently. From a practical standpoint roentgen radiation is preferable. Dosage should be divided in individual exposures, heavily filtered, employed in the highest voltages and greatest distances practical, and carried to the maximum of skin tolerance on a daily treatment basis. In determination of the exact maximum of filter, distance, individual exposure and frequency, lies our greatest problem of the present day.

If no nodes are palapble in the neck, the external irradiation is all that is indicated, except a careful methodical clinical follow-up at frequent intervals. It is not possible to carry on this type of work with fairness to the patient without the most careful attention to the follow-up and periodic examination.

Interstitial Irradiation of Metastatic Nodes. When we consider the narrow limits which we have placed on dissection it at once becomes apparent how diverse are the conditions in which implantation must be employed. External irradiation can be depended upon only in the strictly anaplastic growths. It is true that many intraoral tumors clear up without metastases. The gradual lowering in percentage of cases developing nodes after admission (when admitted free from palpable nodes) is a tribute to the gradually increasing efficiency of external therapy as a preventive measure. However, there are many metastatic node problems between the palpably uninvolved necks and those suitable for surgical dissection. Implantation should not be resorted to for interim or expected short-term palliation; this is a problem for external irradiation. Interstitial irradiation should aim at "cure" or long-time palliation.

Resort to the method of implantation, whether seeds or needles, presupposes, therefore, a substantial or complete control of the primary growth. With undifferentiated growths it is a method of election. There are many fully differentiated metastatic nodes, and with intact capsules, where for constitutional or certain local reasons, as previously indicated, interstitial irradiation is preferable to dissection. Nodes in which the disease has infiltrated beyond the capsule are again treated interstitially through choice. The same is true for bilateral nodes whether or not encapsulated.

It should be repeated that maximum external therapy should always precede implantation. Under all circumstances it is the first step in the treatment of both primary and secondary involvements. Implantation should practically never be carried out through skin puncture. If the disease is so extensive as to make surgical exposure unnecessary, it is at the same time too advanced to warrant interstitial irradiation. It is utterly impossible, except by accident, to make accurate distribution in the average metastatic cervical node through a skin puncture. The possibility of damage to vital structures is too great. A simple surgical exposure can be made with ease under local anesthesia. The dissection for exposure should be no more than is necessary. Needless dissection for exposure is meddlesome surgery: it interferes too sharply with the surrounding blood supply. The greater the interference with surrounding

blood supply the less satisfactory the local reaction to irradiation. Implantation may at times be combined with the exposure for ligation of the external carotid, or its branches.

On exposure of a node for implantation, it is usually advisable to aspirate, to determine, and possibly relieve, a liquefied centrally necrotic area. The trauma is slight, and the benefit, through avoidance of undue subsequent inflammatory reaction, is considerable. With extensive central liquefaction necrosis, it is even advisable to pack the cavity within the node for a few days with iodoform gauze to prevent reaccumulation of serum and until the interstitial irradiation begins to show gross effect.

If radon seeds are employed the wound may be closed tightly except for a small forty-eight hour drain. I do not favor removable needles for this work; it traumatizes the wound to withdraw them and is apt to be a serious deterrent to primary healing.

The size of the mass to be implanted is of some importance. Very large metastatic areas are unsuitable because of the amount of emanation necessary to afford growth control or a substantial degree of growth restraint. The smaller and more sharply defined the node, the better chance for success by this method.

It is my opinion that narrowing of the limits for dissection and gradually increasing the scope of interstitial irradiation of metastatic nodes, after full external therapy, has conferred a larger benefit on a greater number of patients than did the former plan of free resort to dissection without adequate selection of cases.

COMPARISON OF HIGH VOLTAGE ROENTGEN-RAY TUBES

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ABSTRACT

A comparison of the roentgen-ray output as a function of the applied voltage has been made for two thin glass roentgen tubes, five thick glass tubes, and one metal-centered tube on several generators of different voltage wave form. Thin glass tubes show about 15 per cent greater output than thick glass tubes on constant potential, while the metal-centered tube gave about 15 per cent less output. At any given effective (r.m.s.) voltage, the outputs of all glass tubes or all generators were nearly the same, and equal to the output on a constant potential of the same value. Likewise, at a given effective voltage, the quality (full absorption curve) was the same for all tubes on all generators.

Outputs of all tubes at a given peak voltage varied over a range of 25 per cent between tubes and between different generators. The metal-centered tube output varied widely between half- and full-wave rectification at equal peak voltages. The same tube, however, gave the same output at any given effective voltage supplied by any generator.

I. INTRODUCTION

PREVIOUS papers[1,2,3,4] have dealt with the relationship between the applied roentgen-ray tube voltage and the intensity and quality of the emitted radiation measured under given filtrations and other conditions. It was found for a wide variety of applied voltage wave forms that, regardless of the peak voltage, the resultant roentgen-ray qualities as given by a full absorption curve are alike for any given effective voltage; also the outputs per effective milliampere[4] for a given tube operated on the various voltage wave forms are nearly the same at any given effective voltage. As a consequence the quality (and intensity, to a certain extent) of all radiations is expressible in terms of two readily measured quantities, the effective tube voltage and effective tube current.

This previous work was carried out with thin-walled glass Coolidge tubes which are free from certain inherent disadvantages present in other tubes. In order that the relationship between quantity, quality. and effective tube voltage might be more completely generalized, however, it is of course necessary to investigate the effect with other types of tubes and generators.

Most prominent among the newer tubes are the several American makes of thick-walled pyrex tubes, and the foreign tubes of the metal-centered type. In operating the thick-walled tubes on a fluctuating voltage, it is found that the output changes (usually decreases) some 20 per cent during the first few minutes of operation, even though the average tube current and transformer primary (r.m.s.) voltage are held constant.[5,6] This is caused by current and voltage wave-form change arising from the interaction of the transformer and tube, which change in turn is caused by a high electrostatic charge on the tube walls acting as a charged grid when the tube is cold but which is dissipated as the glass is heated up. It was then found that by maintaining the effective tube voltage and current constant during the transition period, a change in output no longer occurred. That is, output readings for any effective

[1] Taylor, L. S., and Tucker, K. L. The comparison of high voltage roentgen-ray generators. *Bur. Standards J. Research*, 1932, *9*, 333 (RP475). Also Am. J. Roentgenol. & Rad. Therapy, 1933, *29*, 826–843.

[2] Taylor, L. S., Singer, G., and Stoneburner, C. F. *Bur. Standards J. Research*, 1932, *9*, 561 (RP491).

[3] Taylor, L. S. *Strahlentherapie* (in press).

[4] Taylor, L. S., Singer, G., and Stoneburner, C. F. Effective applied voltage as an indicator of the energy emitted by a roentgen-ray tube. Am. J. Roentgenol. & Rad. Therapy, 1933, *30*, 221–228.

[5] Gross, M. J. Transient K. V. P. and r output from air-cooled therapy tube. *Radiology*, 1933, *20*, 14–17.

[6] Taylor, L. S., and Stoneburner, C. F. *Bur. Standards J. Research*, 1933, *10*, 233 (RP527).

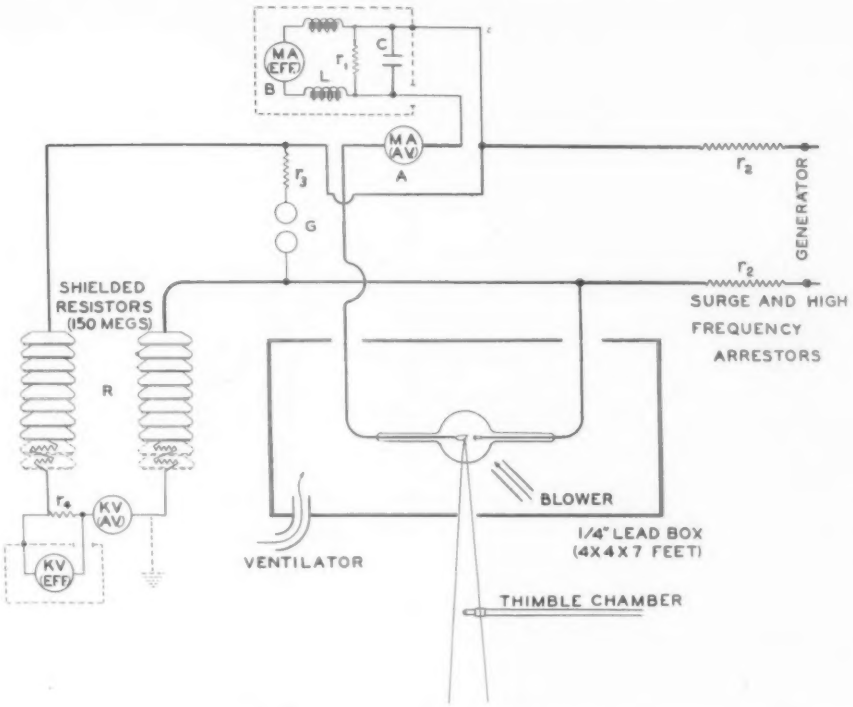

Fig. 1. Diagram showing arrangement of apparatus used in the comparison of roentgen tubes.

voltage and current are characteristic of the tube, irrespective of accumulated charge on the glass walls. On the other hand, using the customary peak voltage and average current measurements, sufficient time must be allowed to permit the tube to reach a steady state before making output measurements.

While this grid action is not present in the metal-centered type of tube, another difficulty in arriving at an adequate comparison of tubes is introduced through the elimination of stem radiation from the ionization readings. With the common glass tube, stem radiation may amount to 10 to 20 per cent of the total,[7] and this in general is of a considerably softer quality than the focal spot radiation.[8,9]

In view of the above described tube differences, the principal purpose of this investigation was to further compare the operation of several typical roentgen tubes on a group of typical generators.

II. EXPERIMENTAL RESULTS

1. *Tubes and Generators Employed.* The arrangement of the equipment is the same as in our recent studies of generators.[10] The tube was in a lead box 4×4×7 feet, lined with $\frac{1}{4}$ inch of lead (Fig. 1), with a fixed insulating support insuring a uniform distance from the center of the target to the ionization chamber. In addition to the box being well ventilated, a strong blast of air could be directed against the tube walls.

Simultaneous measurements were made of the effective (r.m.s.) tube voltage and current, peak voltage, average voltage, and average current in the high tension circuit The average and effective voltage were measured by means of a 150-megohm coronaless shielded resistor[11] used as a voltmeter multiplier. As before, to avoid possible uncertainties in the comparison of

[7] Coolidge, W. D., and Moore, C. N. *General Electric Rev.*, April, 1917, p. 272.
[8] Lorenz, E. *Proc. Nat'l Acad. Sc.*, 1928, *14*, 582.
[9] Taylor, L. S., and Singer, G. *Bur. Standards J. Research*, 1931, *6*, 219 (RP271).
[10] See footnote 1.
[11] Taylor, L. S. *Bur. Standards J. Research*, 1930, *5*, 609 (RP217).

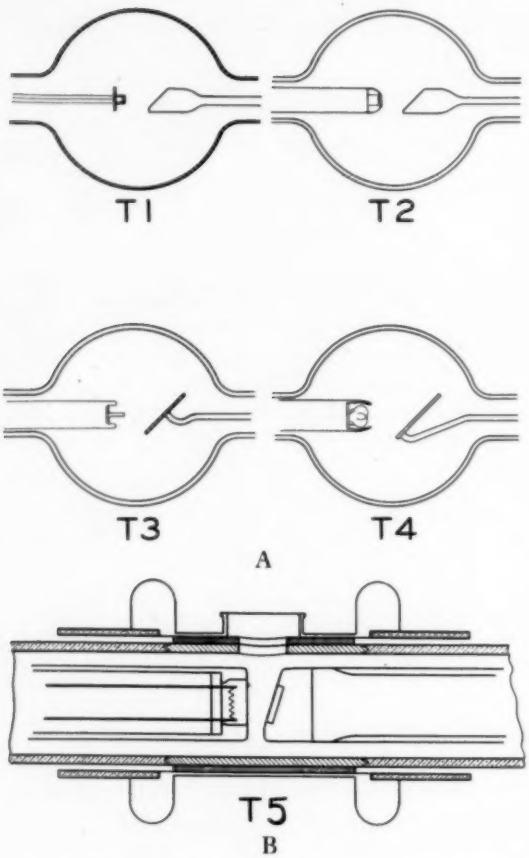

FIG. 2. Schematic diagram of roentgen tubes employed, showing essential details of construction. A. Glass tubes. B. Metal-centered tube.

tubes, the aerial system was kept the same for all generators. Tubes and generators could be changed within a minute's time. The results have been checked repeatedly over a period of several months.

Radiation emerged from the box through a 10 cm. aperture (similar to conditions used clinically) giving a beam about 14.5 cm. in diameter at the ionization chamber. A fixed filter of 0.557 mm. Cu + 1.0 mm. Al was placed over the aperture with the copper toward the tube. Ionization measurements were made in air with a calibrated thimble chamber at a distance of 50 cm. from the target center, particular care being taken to avoid the inclusion of any spurious (scattered) radiation, particularly back-scattering and scattering from the diaphragm. The only difference between this arrangement and the one previously used in our generator comparisons[12] is in the diameter of the field at the point of measurement. In the earlier work (with thin-walled tubes) the field diameter was 5.5 cm. as compared with 14.5 cm. in this work. The resulting difference in measured ionization was 9.0 ± 0.4 per cent at all voltages and is attributable to the inclusion of more stem radiation in the larger field. The measurements given here for thin-walled tubes are our earlier values increased by 9 per cent, which change renders the results in this paper directly comparable with our earlier work. The following high voltage generators, as previously designated, were used:

(*A*) Transformer, two-pole (previously used on mechanical rectifier).
(*B*) Mechanical rectifier, double high-tension transformer in single tank, rectifies 20 degrees of cycle.
(*C*) Constant potential, commercial, 2 per cent ripple per milliampere.
(*D*) Half-wave kenotron rectifier.
(*E*) Full-wave kenotron rectifier.
(*F*) Constant potential (Bureau of Standards standard), 0.2 per cent ripple per milliampere.

The following roentgen tubes (Fig. 2) were used:

T1, (2 tubes) thin glass, massive target.
T2, (2 tubes) thick glass, massive target.
T3, (2 tubes) thick glass, disc target.
T4, (1 tube) thick glass, disc target.
T5, (1 tube) metal-centered, line focus, water-cooled (thermo-siphon).

It may be stated here that all tubes of the same make and type gave practically the same output on any one generator so the results obtained with one tube only of each type are given.

2. *Output on Constant Potential.* In Figure 3 is plotted on two curves the output in roentgens per minute per milliampere of the various tubes operated on constant potential. As pointed out previously there is no appreciable difference between the outputs using generators (*C*) and (*F*) although

[12] See footnote 4.

the ripplage of (*F*) is only about a tenth that of (*C*). The lower curve, for the thick-walled tubes (T2, T3, and T4), clearly shows no appreciable difference between the outputs per milliampere at any given voltage. The upper curve, for the thin-walled tube (T1), shows a considerably higher output than the thick-walled at all voltages, ranging from about 17 per cent at 105 kv. to 14 per cent at 145 kv. A decrease in relative output with increased voltage is to be expected, since at the higher voltages, the radiation being harder, the absorption in the thick glass walls becomes relatively less.

3. *Roentgen-Ray Output per Average Milliampere.* As in our previous study of roentgen generators, output curves obtained under the more common criteria of control are given first to show the limitations therein. In comparing the tubes operated on different generators, it is least confusing to group on one graph the outputs of all the tubes on one particular generator. Figures 4, 5, and 6 show the output per average milliampere for the full-wave (*E*), half-wave (*D*), and mechanical rectifier (*B*), respectively, as a function of the peak voltage. The upper curve in all three figures is for tube T3 on the constant potential generator (*C*).

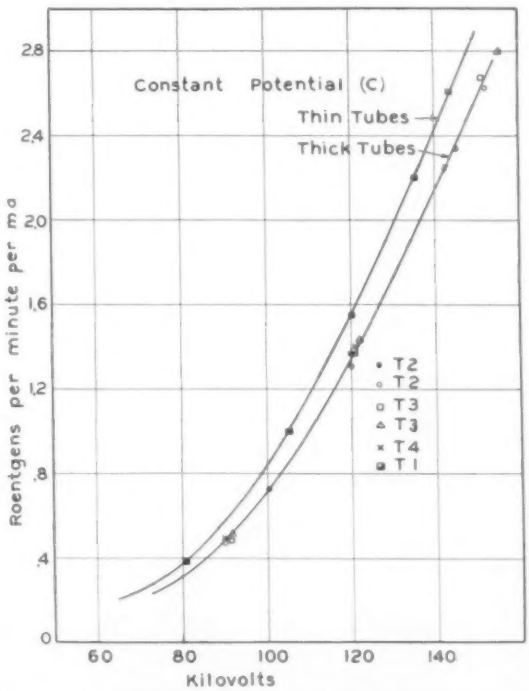

Fig. 3. Output of roentgen tubes on constant potential.

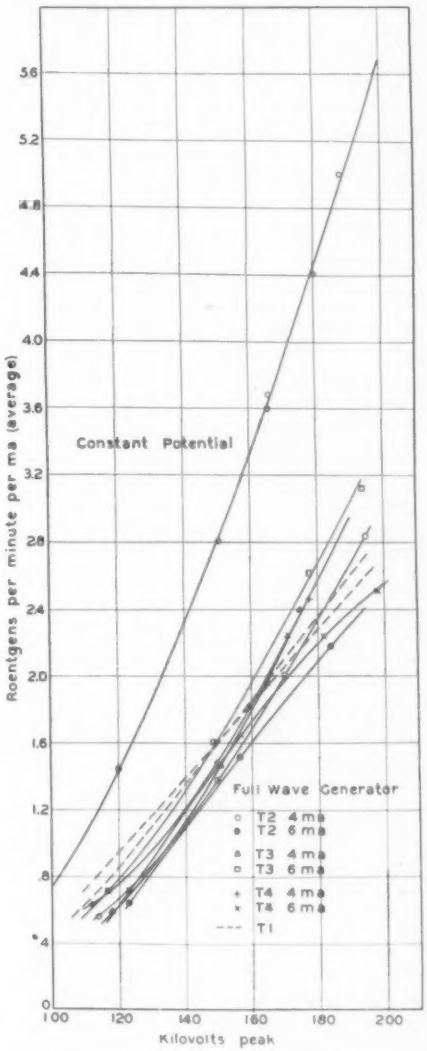

Fig. 4. Output per average milliampere of roentgen tubes as a function of peak voltage on full-wave generator.

It is evident from the curves that there is a considerable difference between the outputs of individual tubes when operated on the same generator. At 180 kv. (peak) the maximum difference on the full-wave rectifier is about 28 per cent; on the half-wave rectifier, about 32 per cent; and on the mechanical rectifier, about 35 per cent.

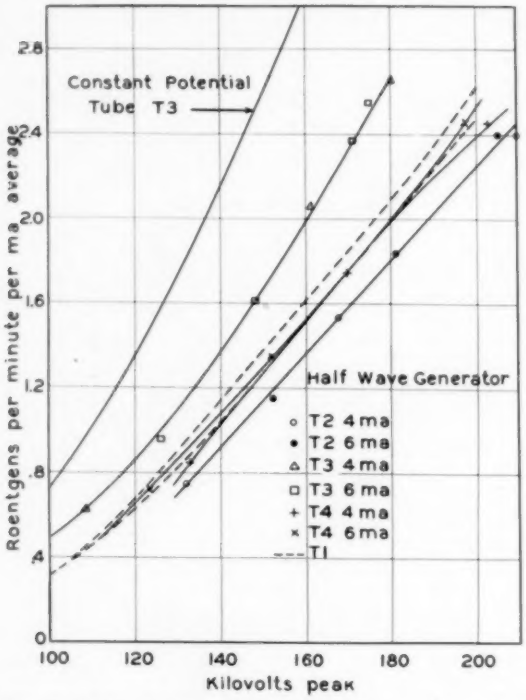

FIG. 5. Output per average milliampere of roentgen tubes as a function of peak voltage on half-wave generator.

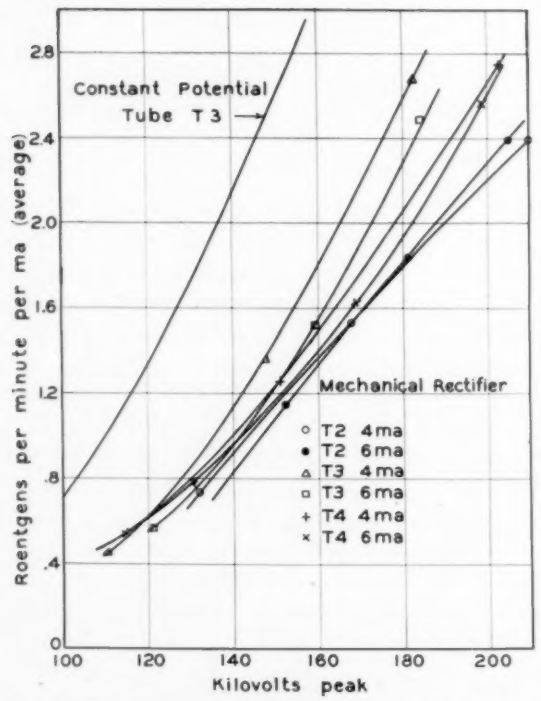

FIG. 6. Output per average milliampere of roentgen tubes as a function of peak voltage on mechanical rectifier.

Part of the difference is attributable to differences in the transformer design but earlier studies have shown that there is not necessarily any similarity between the outputs produced by half-wave and full-wave rectifiers operating on the same transformer.[13]

Differences between tubes appear to be for the most part random. However, in all of the curves the output per average milliampere of tube T3 is predominantly higher than the others at any given peak voltage.

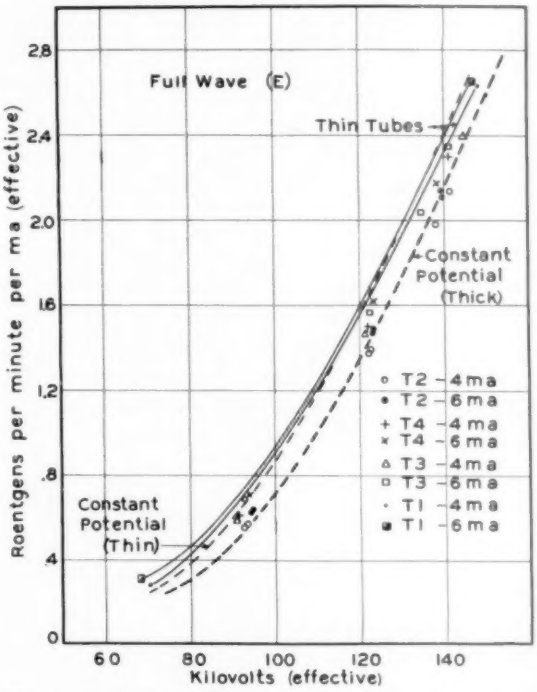

FIG. 7. Output per effective milliampere of roentgen tubes as a function of effective voltage on full-wave rectifier.

It is also seen that while occasionally there is no difference in output per average milliampere for a given tube when the magnitude of the tube current is changed, this appears to be largely accidental and dependent upon the particular circuit conditions for which the measurements were made.

It should be emphasized that the basing of any general conclusions regarding the relative efficiency of tubes, based on meas-

[13] See footnote 4.

urements of peak voltage and average tube current is unsafe. Depending upon the generator and tube current, such a wide range of outputs is obtainable under supposedly the same conditions as to render the results almost meaningless.

4. *Roentgen-Ray Output per Effective Milliampere.* Earlier investigations with thin-walled tubes operated on a group of representative generators, showed a much closer agreement in output at any given values of the effective tube current and effective voltage.

The curves in Figures 7, 8, and 9 likewise show a close relationship for the thick-walled tubes on full-wave (*E*), half-wave (*D*), and mechanical rectifier (*B*), respectively. Data plotted for the thin tube are taken as before from a recent paper and corrected as noted above to the larger field area used in this study. The lower broken line curve in Figures 7 to 9 is for constant potential on the thick tubes and is taken from Figure 3.

In Figure 7 for the full-wave generator

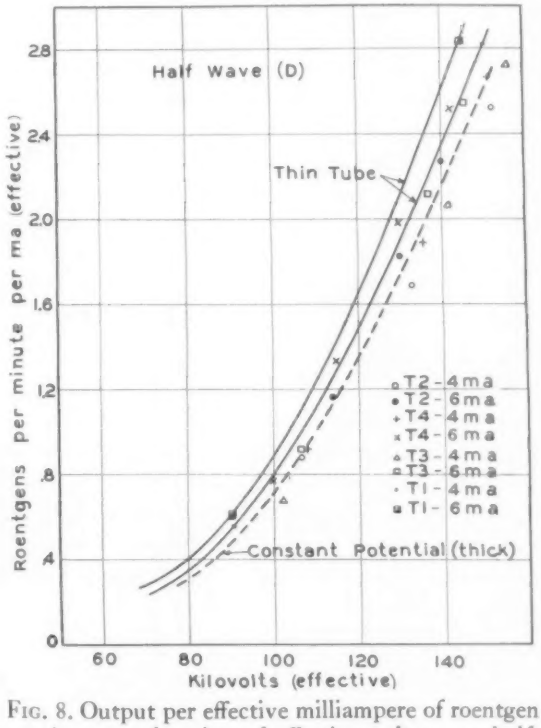

Fig. 8. Output per effective milliampere of roentgen tubes as a function of effective voltage on half-wave rectifier.

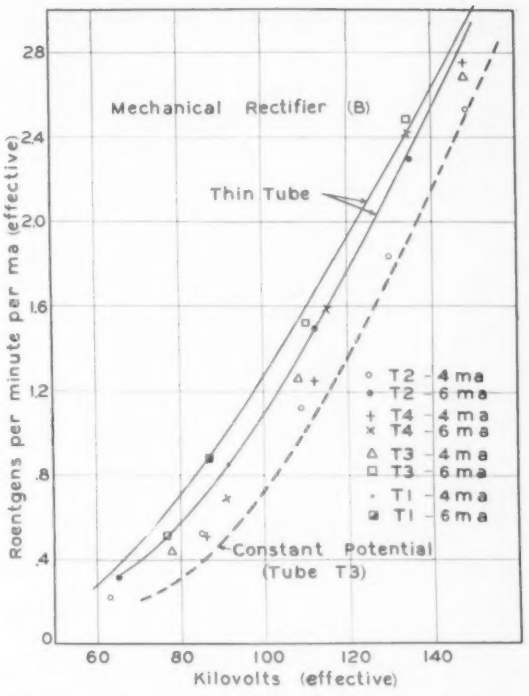

Fig. 9. Output per effective milliampere of roentgen tubes as a function of effective voltage on mechanical rectifier.

(*E*) the points for the various tubes are scattered somewhat at random about the constant potential curve; in general, the outputs per effective milliampere are approximately the same. The upper broken line curve is for constant potential (from Fig. 3) on the thin tube (T1) and the two adjacent curves are for the same tube on the full-wave generator. The separation between the two constant potential curves is to be ascribed to the difference in filtration of the thin and thick glass walls.

In Figure 8, for the half-wave generator, it is again seen that the outputs per effective milliampere are grouped fairly closely and at random about the constant potential curve. To obtain these curves the actual meter readings of the voltage and current were corrected, as in our earlier work, by the factors $\sqrt{2}$ and $\sqrt{1/2}$, respectively, in order to make proper allowance for the suppressed half-wave.[14] The two full-line curves for the thin tube (T1) again show a

[14] See footnote 4.

consistently higher output at a given voltage.

Figure 9 for the mechanical rectifier (*B*) shows appreciably higher outputs than for constant potential of the same effective

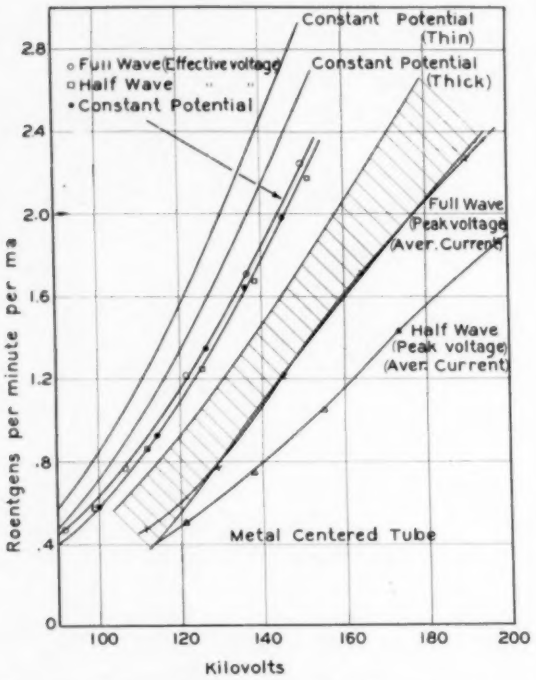

FIG. 10. Output per milliampere of metal-centered tube on different generators.

voltage. This, however, corresponds to earlier findings and in any case the agreement with constant potential is much closer than by any other method of measurement.

To summarize the results in the last three sets of curves, it may be said that the relationships between output per effective milliampere and effective voltage for thick-walled roentgen tubes follow closely the more detailed results previously presented for thin-walled tubes.

5. *Measurements on Metal-Centered Tube* (T_5). Due to the fundamentally different construction of the metal-centered tube (T_5) as compared with the glass-walled tubes, the output measurements thereon do not fall in with the other curves.

The curves in Figure 10 show for this tube the output per milliampere as a function of the applied voltage. The curves are individually labeled as to whether the ordinates are for average or effective tube current, and the abscissae for peak or effective voltage. The tube was operated at the single current of 4 ma. (average) which is its maximum rating.

It will be noted that on constant potential the output per milliampere of the metal-centered tube is about 35 per cent less than for the thin-walled tube and about 16 per cent less than for the thick-walled tube. As previously noted, this lowered output is probably due partly to the loss of stem radiation which is prevented, by the metal shield, from leaving the tube.

It is also seen that the output per average milliampere as a function of the peak voltage is less than the average value for all the other tubes on the full-wave generator. The shaded area indicates the region within which the output curves for the glass-walled tubes lie. For the half-wave generator the output per average milliampere for the metal-centered tube is some 30 per cent lower than on the full-wave generator at the same peak voltage, whereas we have shown before that for glass-walled tubes the difference introduced by use of the two types of wave-form has comparatively little effect on the output per milliampere. This great decrease in output on the half-wave generator is due to the wave distortion introduced by the current-limiting characteristics of such tubes.

As contrasted with the behavior of this tube on half- and full-wave generators when controlled by average current and peak voltage, it is found that the output per effective milliampere, as a function of the effective voltage, follows closely the output for constant potential. On this basis of comparison, the roentgen-ray output for tube (T_5) is the same for all generators and thus conforms to the results found with glass tubes.

6. *The Relationship of Roentgen-Ray Quality to Voltage Measurements.* It has been shown by Silberstein[15] that radiations having the same complete absorption

[15] Silberstein, L., *Phil. Mag.*, 1933, *15*, 375.

curves in copper (or aluminum) have likewise the same effective spectral distribution. Also, we have shown in recent studies, using thin-walled tubes, that radiations produced by the same effective voltage (by whatever voltage wave form, including constant potential) yield very closely the same full copper absorption curve, regardless of the peak voltage.

This is corroborated by the semilogarithmic copper absorption curves in Figure 11. Curves A are for the tubes T1 to T5 operated on a constant potential of 141.4 kv. It is seen that at least after an initial filtration of 0.28 mm. of copper, the absorption curves—and hence the quality—are all alike within reasonable limits. Tubes T1 and T4 do, however, appear to give a very slightly softer radiation than T2 and T3, which is to be expected since the latter tubes have the heaviest walls of the group.

Curves *B* show similar results for tubes T3 on all generators, and tube T5 on constant potential and full-wave rectifiers, all at 141.4 kv. (effective) but at very different peak voltages. The two curves are identical with those in *A* and show that again the qualities are essentially the same on all generators at a given effective voltage. (The measured value of the effective voltage for the half-wave generator of 100 kv. for the full cycle was corrected by the factor $\sqrt{2}$ to give the true value during the useful half cycle.) Tube T5 appears to yield a slightly harder radiation than the glass tubes, on both constant potential and full-wave rectification. This is probably due to the loss of the softer stem radiation which cannot contribute to the final result as in the case of the other tubes.

Our earlier conclusion is thus corroborated that (1) the quality of any roentgen-ray beam may be adequately specified in terms of the constant voltage necessary to produce the same absorption curve; (2) the qualities of the roentgen-ray beams produced by any tube, in conjunction with different generators, are the same for a given effective (r.m.s.) voltage applied to

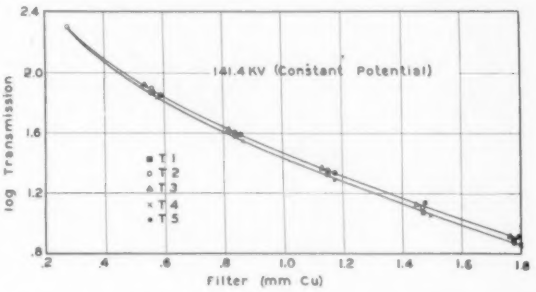

Fig. 11A. Copper absorption curves obtained with various glass roentgen tubes on constant potential.

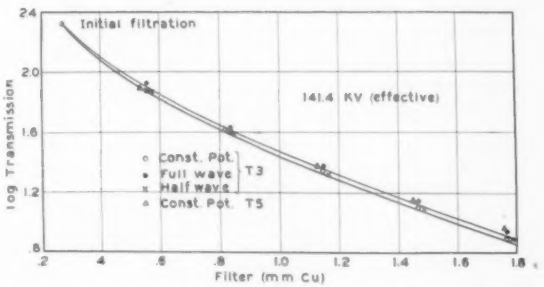

Fig. 11B. Copper absorption curves obtained with thick glass roentgen tube and metal-centered tube on various generators.

the tube; (3) while there are necessarily small differences in output, due to such factors as wall thickness or elimination of stem radiation, these sources are readily recognized and allowances made therefor; and (4) with the conventional methods of measuring tube voltage and current, a wide range of outputs and qualities are obtainable.

This work has been made possible through the cordial cooperation of the American manufacturers of roentgen tubes and equipment, to whom we express our appreciation.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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19th Annual Meeting: Cleveland, June 10–11, 1934.

EDITORIAL

RADIOLOGIC SERVICE IN THE UNITED STATES

THE Council on Medical Education and Hospitals of the American Medical Association has recently presented its fourth publication* of a list of physicians specializing in radiology. The list now contains 1250 names of physicians who have been found qualified in the various branches of radiology as defined in the "Essentials" which were accepted by the Council and ratified by the House of Delegates of the American Medical Association.

The following quotation from the report indicates the attitude of the Council and their hopes for the future:

From the beginning of this work the Council has emphasized the fact that the practice of radiology is the practice of medicine. The field of radiology had attracted ambitious persons of a mechanical turn of mind for the reason that the work employs mechanical devices and it appears to the uninformed public that little training or special knowledge is necessary. A large number of lay persons trained as technicians had established radiological laboratories. In many instances, physicians themselves patronized these laboratories and thus fostered them. Often lay controlled and operated laboratories hire physicians to sign their reports and otherwise "use" their names. The designation by the Council of those qualified in radiology has been far reaching in its effects. The principles of medical ethics have been effectively stressed. Without doubt, numerous practicing physicians have been weaned away from supporting lay specialists in this field. The opposition to lay practitioners entering x-ray work independently has been efficacious. Improperly qualified physicians are being dissuaded from holding themselves out as radiologists. Instances are not lacking in which certain practicing radiologists have been induced to improve their business methods and in some instances to withdraw the use of their names from lay "picture factories." By the regular publication of lists of accredited radiologists, physicians generally are encouraged to refer their work to qualified medical graduates.

The excellent cooperation given the Council by the national radiologic societies and the advisers in the various sections, who are themselves prominent radiologists, has made possible the development of the Council's present list. The maximum value and the continued wholesome effects of this published list are in direct proportion to the cooperation extended by the physicians in the specialty.

The report does not exaggerate the importance of the attempt of the American Medical Association to establish standards for the practice of radiology nor the effects of the publication of lists of physicians who are adjudged qualified under such standards. It is another step in the progress which was begun in 1925 with creation of a Section on Radiology in the American Medical Association. The importance of these initial steps is not diminished by the fact that there is still much to be accomplished in order to make our practice conform more closely to the ideals set forth in the "Essentials."

One of the weak points so far has been the absence of any authoritative body to investigate and certify to the qualifications of radiologists. This has been eliminated by the formation of The American Board of Radiology. Within a comparatively short time it is probable that most of the qualified radiologists in the United States will hold the certificate of the Board. Eventually this can be used as the basis for lists of qualified radiologists.

The first essential in assuring the future of radiology is a high standard of radiological work; the charlatan, the unqualified practitioner and the lay operated x-ray

* *J. Am. M. Ass.*, Feb. 24, 1934, *102*, 607–618.

laboratory must be eliminated. The education and training of the radiologist must fit him to act as a consultant; more and more he must assume the position of a clinician; in his hospital relations he must occupy the same status as all other members of the staff.

The second essential is to foster the understanding of radiological problems by physicians generally and to secure the constant cooperation of all branches of the medical profession. It is increasingly apparent that improvement in the standards of medical practice, particularly in the specialties, can be greatly facilitated by the close cooperation of all branches of medicine. In this connection it is significant that very recently there has been formed an "Advisory Board for the Medical Specialties." Its development has been participated in by representatives of the Council on Medical Education and Hospitals of the American Medical Association, the National Board of Medical Examiners, the Association of American Medical Colleges, the Federation of State Boards for Medical Licensure and each of the Boards which now conduct examinations for several of the specialties. The new Board for Radiology was admitted to membership on the Advisory Board at a recent meeting in Chicago. Every movement of this kind serves to cement the relationship of radiology with other specialties and to make it an integral part of organized medicine.

The third essential, and one very important at the present time, is the establishment of ethical and economically sound methods for the practice of radiology in hospitals.

At a recent conference on this subject in Chicago, conducted by the American College of Radiology, addresses were made by Drs. Wilbur, McEachern and Caldwell, representing respectively the Council on Medical Education and Hospitals of the American Medical Association, the American College of Surgeons, and the American Hospital Association. During the discussion which ensued the following principles were set forth to govern the relations of radiologists to hospitals:

1. A hospital is a joint enterprise of physicians, on the one hand, furnishing medical care, and of the hospital corporation, on the other hand, furnishing hospitalization. This essential partnership relation should be recognized at all times and the assumption should never be permitted that the physician is simply a servant to be employed or discharged at the will of the corporation. The hospital should not engage in the corporate practice of medicine, either directly by collecting fees for the medical services of its staff or indirectly by furnishing medical care as a part of group hospitalization or flat-rate payment plans.

2. The practice of radiology is the practice of medicine and the radiologist therefore occupies the same relation to the hospital as other members of the staff.

3. It follows that the radiologist should not become a salaried employe of the hospital except where such salary is to reimburse him for special services in teaching, research or to free patients. Those institutions in which all members of staff are on salary also constitute an exception.

4. The arrangement between the radiologist and the hospital should recognize his status as a private practitioner carrying on his practice under the conditions imposed by the hospital location. As such he occupies the same financial relation to his private patients as other physicians in private practice.

5. The financial arrangement of the radiologist with the hospital should recognize the following points:

A. The hospital is entitled to reimbursement either in cash or services for rent, light, janitor service and other expenses incurred in maintaining the radiological department.

B. If the hospital has equipped the radiological department it is entitled to reimbursement over the period of the agreement for obsolescence of the equipment, but should bear a proportionate share of such absolescence based upon the ratio of pay patients to free patients.

C. The expense of operating the radiological department should be borne by the radiologist but he should be

reimbursed by the hospital for expense incurred in examining free cases.

D. If the free work forms a very considerable portion of the total volume of radiological work it will be necessary to make some special arrangement whereby it may be subsidized.

It is recognized that the above principles must be modified to fit specific conditions and that there are many hospitals in which they cannot be fully carried out. They form the basis, however, for a practical arrangement which is ethically and economically sound. Through an arrangement based upon such principles a hospital may be assured a first class radiological department and the radiologist can practice medicine on the same high plane as his colleagues in other branches.

At the present time the economic problems of medicine are under discussion in nearly every community. The radiologist must be alert to take his part in helping to guide and control the many new schemes that are constantly being put forward, both as to their possible effect upon his own specialty and upon medicine in general and in the end upon the public welfare.

In the light of all these considerations it is very timely to have the report of the Council on Medical Education and Hospitals with a re-statement of the "Essentials" for practice of radiology and a list of the physicians subscribing to such principles.

Arthur C. Christie

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. E. P. Pendergrass, University Hospital, Philadelphia, Pa.
Annual Meeting: Pittsburgh, Pa., Sept. 25–28, 1934.

American College of Radiology
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual meeting: Cleveland, 1934.

Section on Radiology, American Medical Association
Secretary, Dr. J. T. Murphy, 421 Michigan St., Toledo, Ohio.
Annual meeting: Cleveland, Ohio, June 11–15, 1934.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N.Y.
Annual meeting: 1934, to be announced.

Radiological Section, Baltimore Medical Society
Secretary, Dr. W. B. Firor, 1100 N. Charles St., Baltimore.
Meets third Tuesday in each month from September to May.

Radiological Section, Los Angeles County Medical Society
Secretary, E. N. Liljedahl, Los Angeles, Calif.
Meets on the third Wednesday of each month at the California Hospital.

Radiological Section, Southern Medical Association
Secretary, Dr. F. B. Bogart, Medical Arts Bldg., Chattanooga, Tenn.
Annual meeting: San Antonio, Texas, November, 1934.

Brooklyn Roentgen Ray Society
Secretary, Dr. G. W. Cramp, 921 President St., Brooklyn, N.Y.
Meets monthly on first Tuesday, October to April.

Buffalo Radiological Society
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St., Buffalo, N.Y.
Meets second Monday of each month except during summer months, place of meeting selected by the host.

Chicago Roentgen Society
Secretary, Dr. R. G. Willy, 1138 N. Leavitt.
Meets second Thursday of each month October to May inclusive at the Palmer House.

Cincinnati Radiological Society
Secretary, Dr. H. G. Reineke, Christian R. Holmes Hospital, Cincinnati, Ohio.
Meetings held monthly.

Cleveland Radiological Society
Secretary, Dr. Otto Glasser, Cleveland Clinic.
Meetings are held at 6:30 P.M. at the Cleveland Chamber of Commerce Club rooms on the fourth Monday of each month from October to April, inclusive.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. E. R. Witwer, Harper Hospital.
Meets monthly on first Thursday from October to May, at Wayne Country Medical Society Building.

Florida Radiological Society
Secretary, Dr. W. McL. Shaw, 418 St. James Bldg., Jacksonville, Fla.
Meetings held twice a year, May and November.

Illinois Radiological Society
Secretary, Dr. H. W. Grote, 219 N. Main St., Bloomington, Ill.
Regular meetings held quarterly.

Indiana Roentgen Society
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.

Michigan Association of Roentgenologists
Secretary, Dr. S. W. Donaldson, St. Joseph's Mercy Hospital, Ann Arbor, Mich. Three meetings a year, Fall, Winter, and Spring. Next meeting, Grand Rapids, Mich., May, 1934.

Milwaukee Roentgen Ray Society
Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee, Wis.
Meets first Friday in October, December, February, and April. Place of meeting designated by the president.

Minnesota Radiological Society
Secretary, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.

New England Roentgen Ray Society
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

New York Roentgen Society
Secretary, Dr. C. W. Schwartz, 33 E. 68th St., New York.
Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Roentgen Ray Society
Secretary, Dr. Major Fleming, Rocky Mount, N.C.
Annual meeting at time and place of State Medical Society. Mid-year scientific meeting at place designated.

Central New York Roentgen Ray Society
Secretary, Dr. F. C. Rulison, Medical Arts Bldg., Syracuse, N.Y.
Three meetings a year—January, May, and November.

Pacific Roentgen Club
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif.
Meets annually, during meeting of California Medical Association

Pennsylvania Radiological Society
Secretary, Dr. W. E. Reiley, Clearfield, Pa.

Philadelphia Roentgen Ray Society
Secretary, Dr. Karl Kornblum, Graduate Hospital.
Meeting first Thursday of each month from October to May inclusive, at 8:15 P.M., in Thompson Hall, College of Physicians, 19 S. 22d St.

Rochester Roentgen Ray Society, Rochester, N.Y.
Secretary, Dr. W. W. Fray, Strong Memorial Hospital.
Meets monthly on second Thursday from October to May, inclusive, at 7:45 at the Rochester Medical Association Building.

St. Louis Roentgen Club
Secretary, Dr. W. K. Mueller, University Club Bldg.
Meets first week of each month. Time and place of meetings designated by president.

South Carolina X-Ray Society
Secretary, Dr. R. B. Taft, 105 Rutledge Ave., Charleston.
Meets at time and place of South Carolina State Medical Association.

* Secretaries of Societies not here listed are requested to send the necessary information to the Editor.

Texas Radiological Society
Secretary-Treasurer, Dr. J. H. Smith, Lubbock, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association. Next Meeting. San Antonio, May 7, 1934.

University of Michigan Department of Roentgenology Staff Meeting.
Secretary, Dr. C. B. Peirce, University Hospital, Ann Arbor, Mich.
Meets each Monday evening from September to June, at 7 P. M. at University Hospital.

University of Wisconsin Roentgen Club
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis.
Meets monthly on last Thursday, October to April, Service Memorial Institute, at 4:30 P.M.

Virginia Roentgen Ray Club
Secretary, Dr. V. W. Archer, University Hospital, University, Va.
Meets annually in October.

Cuba

Sociedad Cubana de Radiologia y Fisioterapia
Secretary, Dr. Luis Fariñas, Animas 110, Havana, Cuba.
Meets monthly in Havana.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

Electro-Therapeutic Section of the Royal Society of Medicine (Confined to Medical Members)
Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

Section of Radiology and Medical Electricity, Australasian Medical Congress
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Radiological Section of the Victorian Branch of the British Medical Association
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

Section on Radiology, Canadian Medical Association
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

Indian Radiological Association
Secretary, Sd. Subodh Mitra, 148 Russa Rd., Calcutta.
Meets annually in January, and at such places and times as the Council may appoint.

Radiological Section, New Zealand British Medical Association
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch. Meets annually.

Continental Europe

Belgian Society of Roentgenology
Secretary, Dr. J. Boine, Avenue des Allies, 134, Louvain, (Belgian).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summer time.

Société de Radiologie Médicale de France
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Société Suisse de Radiologie (Schweizerische Röntgen-Gesellschaft)
Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse, Biel.
Meets annually in different cities.

Société Française d'Electrothérapie et de Radiologie Médicale
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Association of German Roentgenologists and Radiologists in Czecho-Slovakia
Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

Deutsche Röntgen-Gesellschaft (Gesellschaft für Röntgenkunde und Strahlenforschung)
Meets annually in April in different German cities, at least once in five years in Berlin. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent Secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

Dutch Society of Electrology and Roentgenology
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

Societa Italiana Radiologia Medica
Secretary, Professor M. Ponzio, University of Turin, Turin.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Oscar Meller, Str. Banul Maracine 30, Bucharest, Rumania.
Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad, USSR, in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson.
Meets annually.

Leningrad Roentgen Ray Society
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

Moscow Roentgen Ray Society
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

Polish Society of Radiology
Secretary, Dr. Jan. Kochanowski, 45 Gornoslazka St., Warsaw.
Meets annually.

Warsaw Section, Polish Society of Radiology
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summer time.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with exception of the Denmark Society, meets every second month except in the summer time.

Society of Medical Radiology of Sweden
Meets in Stockholm.

Society of Medical Radiology in Norway
Meets in Oslo.

Society of Medical Radiology in Denmark
Secretary, Dr. H. Scheuermann, Copenhagen.
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

Society of Medical Radiology in Finland
Meets in Helsingfors.

Vienna Society of Roentgenology
Meets first Tuesday each month, October to July.

Orient

Japan X-Ray Association
c/o Orthopedic Surgery, Tokyo Imperial University.
Meets annually in April.

Kinki Roentgen-Abend Society
Director, Dr. Prof. Taiga Saito, Ogawaoike, Kyoto, Japan.
Meets bi-monthly on third Sunday.

REPORT OF THE MEETING OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN THE CZECHOSLOVAKIAN REPUBLIC*

PRAGUE, NOVEMBER 4–5, 1933

Again this year the attendance at the Congress included those from within and outside the country; likewise government officers and representatives of other societies were present. The meeting was opened by a practical roentgenologic seminar, led by Altschul. The first session was devoted to investigation of the genitourinary tract. Baensch of Leipzig delivered a report on intravenous urography. He concluded from his experiences that this method yields valuable information concerning physiologic processes, likewise in all congenital anomalies, as well as in cases in which transvesical pyelography is not feasible. But he warned against overrating this method in incipient tuberculosis or early tumors. In this types of cases, retrograde pyelography shows more.

Eisler of Vienna reported on roentgenologic study of the bladder, and recent progress in this field. At the close of these reports, Fleischner of Vienna demonstrated various intravenous pyelograms. Canigiani of Vienna and Gütig and Herzog of Witkowitz contributed a report on the diagnosis of renal tumors. Reimann of Prague demonstrated a case of so-called carbuncle of the kidney. Reiser of Prague recommended his method of study with a small amount of contrast medium and filling with air, which was published in 1927. Hutter of Vienna asserted that the delineation of a ureter for its entire length must be regarded with suspicion.

Sgalitzer of Vienna, Sigmund, Kraus, Altschul and Wenzel of Prague, Steiner of Teplitz and Ghon of Prague participated in the discussion.

On chest diagnosis, Beutel of Prague spoke on the lobular pulmonary focus. Herrnheiser of Prague delivered a communication on the interpretation of mottled chest roentgenograms with particular regard to the vascular network. Neugebauer and Kubat of Prague found as an anatomical substratum of the shadow stripes of the curved sides of the ribs, crest-shaped layers of fat in the pleura.

Kienböck of Vienna gave a paper on so-called articular rheumatism. The little known forms which are usually considered in the broader classification of osteoarthritis deformans and gout, Kienböck classifies as osteomatosis of the joints and hypertrophic "ossidesmosis". Further, the so-called tuberculous rheumatism of Boncet, Kienböck designates as rheumatic joint tuberculosis.

Steiner of Teplitz showed roentgenograms of the bony orbit.

Pokorny of Komotau discussed the different stages of Kienböck's "Lunatummalazie." It is noteworthy that of 11 cases, 8 were in miners.

Schiller from Wlaschim and Altschul of Prague reported on multiple tuberculosis of the bone. Of 593 cases of surgical tuberculosis, 52 had multiple foci, for the most part, on different sides of the body. The mortality was only 4 per cent.

After these presentations on bone diagnosis, there followed a lively debate in which Beutel, Jaroschy, Kienböck, Reimann, Wohlauer, Herzog, Herrnheiser and Sgalitzer took part.

Demel and Sgalitzer of Vienna discussed the diagnostic significance of contrast filling of the peripheral arteries and reported on unexpected therapeutic effects after arteriography. In 36 per cent an unmistakable improvement in the condition of the patients lasting over a year was proved. To Gütig's question as to whether perhaps with the exposure of the artery a periarterial sympathectomy had been accomplished unintentionally which might account for the improvement, Demel answered that the interarterial injection could not be associated with this, and that sympathectomies carried out previously had never had any effect. Altschul suggested

* Translated from the German by Otto Glasser, Ph.D., Cleveland Clinic, Cleveland, Ohio.

an influence through radioactive substances in the contrast medium.

Sigmund of Prague showed roentgenograms and preparations for intestinal invagination. Gütig of Witkowitz showed a case of carcinoma in the cul de sac before anastomosis in a thirty year old patient. Reimann of Prague discussed the roentgen diagnosis of prepyloric stomach carcinoma. Langer of Prague showed roentgenograms of a case of esophageal varices. Jaksch showed the relation of esophageal varices to atrophic cirrhosis of the liver.

Handhauer of Prague demonstrated 2 cases in which it was possible by means of ventriculography to bring into more or less direct vision tumors of the brain.

The second session was devoted to therapy. Bardachzi of Aussig presented a paper on the roentgen treatment of exophthalmic goiter. He recommended in cases of severe hyperthyroidism to attempt first of all safe radiation treatment. In the most severe cases with coma and psychosis the irradiation should be begun after improvement through internal measures. With hyperthyroidism on a constitutional basis operation is out of the question; on the other hand, in toxic adenoma, operation is to be preferred, as well as in hyperthyroidism with pressure symptoms.

Following this, Löw-Beer of Prague discussed indirect irradiation for hyperfunctional thyroid disorders. Borak, Fried, Herrnheiser, Reiser and Schneider participated in the discussion.

The second report by Fried of Breslau concerned the roentgen treatment of arthritis. He demonstrated his good experiences by roentgenograms in which a patient was shown before and after treatment. Following this Hellebrandt spoke on his experiences and brought further contributions to the roentgen therapy of arthritis. Altschul explained the underlying function of radium chloride injections, and Reiser talked on irradiation of the tonsils. Blonek, Borak, Herrnheiser, Jaroschy and Schneider took part in the further discussion.

Borak of Vienna reported on the radiobiologic retention of the glands of the skin, of which the sweat glands are the most resistant. Heinemann of Prague reported on the roentgen therapy of lymphogranuloma. Gütig of Witkowitz reported the beneficial effects. He referred especially to lymphogranuloma of the intestinal tract, in which the operation first shows the correct diagnosis and demonstrated pictures of a case of this type. In the discussion Steiner, Borak and Löw-Beer took part.

Samek of Prague reported clinical investigations in which it has been proved that through previous irradiation with grenz rays it is possible to decrease sensitiveness to eczema. In view of these investigations, it is advantageous to abandon the older method of irradiation once or serially in favor of strong grenz irradiation. Kalz of Prague made a report on the favorable results with these fractional irradiations in the German Skin Clinic. Schoenhof of Prague said that also in acute cases benefit could be derived from roentgen rays, but administered in very small doses.

Kornalik of Kolin reported biologic investigations on the blood of anuric patients after the application of intracorporeal rays. In the penetration of the living cell by the radiating material is brought to light a biologic principle of importance which with the proper dosage is also applicable therapeutically.

Strauss of Vienna described a new intensity meter, the dositron, for measuring the dose direct on the irradiated area. He also reported on a new integrating instrument for measuring grenz and light rays.

Spiegler of Vienna discussed fully the point of view for the proper exposure of roentgenograms.

Sgalitzer of Vienna discussed at length the advantages of roentgen study of seriously ill patients and those difficult to transport, outside the roentgen laboratory. Demler and Altschul confirmed the cleverness of these investigations.

W. Altschul

ROENTGEN EXAMINATION IN ADDISON'S DISEASE

To the Editor:

I have read with pleasure the Editorial in the January, 1934, issue of the American Journal of Roentgenology and Radium Therapy in regard to "Calcification of the Suprarenal Glands in Addison's Disease." Your Editorial is, to my mind, exceedingly well taken and timely as I have for some time felt that we as roentgenologists are not watching out enough for such relatively rare conditions and are not making thorough enough roentgenological studies of patients regardless of what the attending physician may request, or there is a lack of cooperation between the attending physician and the roentgenologist.

In the September, 1933, issue of *Radiography and Clinical Photography* I published a short note on "Addison's Disease, Radiographically Demonstrated." This describes the typical history of a great number of such cases and how patients have been "going around." This case reported was referred to me in May, 1933, and up to date I have altogether four such cases with practically the same history and record. All of the cases have had careful cholecystographic and gastrointestinal roentgen studies made, but at no time were roentgenograms taken of the kidney region and calcifications in the suprarenal glands were overlooked by the respective roentgenologists. All the cases showed slight and peculiar pigmentation of the skin but they were all suspected "liver cases," and in one of them the gallbladder had been removed without "cure," though the roentgenologist had reported a normal functioning gallbladder in this case.

Therefore it has been a routine for the past few years in my office to take roentgenograms of the kidney region with special reference to the suprarenal areas before any dye or contrast medium is given. This of course often gives negative films but the few cases that are found with calcifications in the suprarenal glands and establish a diagnosis I feel have proved well worth while.

Carl J. Johannesson

TREATMENT OF INTRACAVITARY NEOPLASMS

To the Editor:

I was interested in the article by Stecher and Loughery on "Direct Roentgen Irradiation of Intracavitary Neoplasms" published in the January number of the Journal. From the paper one might infer that this is a new method of treatment. I would like to call attention to the fact that I published a preliminary report on this method of treatment in the American Quarterly of Roentgenology, in December, 1909.* In 1907 we brought from Hamburg, Germany, a set of lead glass treatment tubes, with tube shields and adapters, for treatment of the nose, ear, mouth, rectum and vagina. Some of these have been in use ever since.

A number of cases of uterine carcinoma were treated during the period from 1908 on until we had better methods available. Two patients who had recurrence in the vaginal vault, after operation, who were treated by this method, are alive and well at this time. The patient reported in the original article is alive and well, twenty-four years later.

However, having had considerable experience with the roentgen method we believe that much better results can be obtained by the adequate use of radium by the expert in both intraoral and intravaginal conditions. We have cured many intraoral lesions by the method in the past and yet we know that much better results are now obtained by Pfahler and others by the use of radium. The method may still be of value if the patient is unable to secure proper radium treatment but we feel that this method should not be considered as an adequate substitute for radium treatment in the class of cases discussed in the article.

H. W. Dachtler

* Preliminary report on postoperative roentgen irradiation following the radical operation for carcinoma of the uterus. Am. Quart. Roentgenol., 1909, *2*, 42-51.

FOURTH INTERNATIONAL CONGRESS OF RADIOLOGY

Dr. Soiland, the Secretary of the United States Delegates to the Fourth International Congress of Radiology at Zurich, July 24–31, 1934, has received word from Zurich that up to January 30, 1934, only twelve Americans had registered for the Congress. At each of the former congresses not less than one hundred have gone from the United States. The Journal has published announcements of the Congress in the October, 1933, and February, 1934, issues and from these it will be seen that the program this year will be of unusual interest and scope. Dr. Soiland would urge all who are interested to communicate at once with Dr. H. E. Walther, General Secretary, Gloriastrasse 14, Zurich.

SCIENTIFIC EXHIBIT

The Committee for the Scientific Exhibit at the Thirty-fifth Annual Meeting of the American Roentgen Ray Society to be held at the William Penn Hotel, Pittsburgh, Pennsylvania, September 25–28, 1934, is composed of the following members: Dr. B. R. Kirklin, Chairman, Mayo Clinic, Rochester, Minn., Dr. E. C. Vogt, Dr. J. W. Fisher, Dr. Ira H. Lockwood and Dr. V. W. Archer.

In order that the Scientific Exhibit may be a comprehensive one, it is desirable that those who have material to exhibit communicate with the Chairman, Dr. Kirklin, or one of the other members of the Committee, as soon as possible.

DEPARTMENT OF TECHNIQUE

Department Editor: Robert B. Taft, M.D., 105 Rutledge Ave., Charleston, S. C.

A FRAME FOR HOLDING INFANTS UPRIGHT DURING ROENTGENOGRAPHY

By HORATIO C. WOOD, Jr., M.D.

From the Henry Phipps Institute of the University of Pennsylvania

PHILADELPHIA, PENNSYLVANIA

IT HAS been apparent for some time that better roentgenograms of infants' chests could be obtained through the use of some simple apparatus for holding them in the upright position.

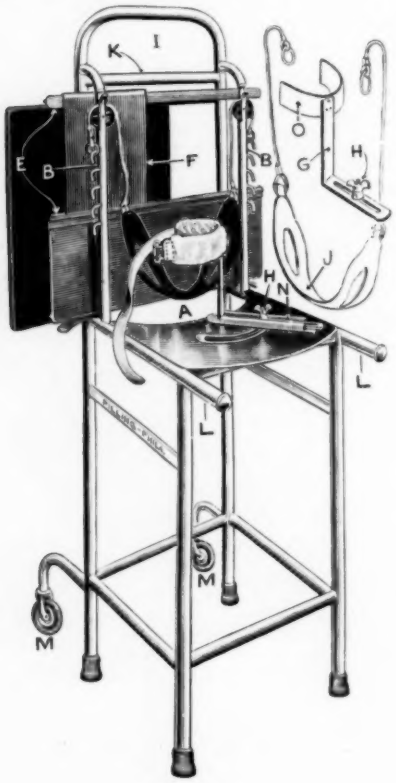

Fig. 1.

Pancoast and Pendergrass[1] have described a chair which they devised for this purpose. In this article they refer to McLean, Remer and Belden as having been convinced of the advisability of examination in the erect posture and say that these authors had stimulated them to work out a technique for this purpose.

At the Henry Phipps Institute we have felt that there were certain diasdvantages in existing methods for obtaining upright films, particularly in regard to the selected rotated positions.[2]

Prior to the use of our frame, the cassette was placed on a low table, the baby was put in position face down upon the film and the tube turned so that the rays were at right angles to the ground.

This method was found unsatisfactory for the following reasons: (1) The child could not be controlled by one person, so that the technician had to assist and in spite of gloves and apron was bound to receive a certain amount of radiation. (2) The adjustment of the tube, placing of the film and the positions of the persons concerned were both timeconsuming and awkward. (3) The infants objected violently to being restrained in the prone position, with consequent struggling and considerable difficulty in holding them sufficiently motionless for clear roentgenograms. (4) The films were not satisfactory because with the child lying face down there was an increase in the intra-abdominal pressure with an upward displacement of the diaphragm. This tends to obscure the bases of the lungs. The angle of the ribs was such that less pulmonary tissue could be seen between them than was the case with the child in the upright position.

The apparatus that we have developed is shown in Figure 1. It consists of a table of convenient height with a metal top

about 16 inches across. A semicircular portion has been cut out at *A* to admit the child's legs. On each side there are two upright supports, *B*, with a notch and a pulley at the top and hooks down the side, on which the hammock, *J*, is adjusted. This canvas hammock is first pulled over the baby's legs and the infant is then suspended between the two uprights, with the rings placed over the proper hooks for bringing the chest up to the desired level on the film. This done the padded lead strip, *O*, is molded firmly around the child's hips and, if desired, the strap is fastened across the abdomen. The steel right-angle, *G*, is then slid forward in its track, *N*, until the baby is held firmly against the cassette. This position is secured by a turn on the thumb screw, *H*.

The mother or nurse stands behind the machine, facing the infant, reaches through the opening, *I*, and by resting her hand on the cross bar, *K*, she can easily keep the baby's arms above its head and out of the field. With her other hand she holds the head slightly forward, so that the occiput will not obscure the apices. This technique is illustrated in Figure 2.

The weight is supported at the hips, there is nothing against which the child can kick and it is very easy for one person to control the patient and hold him almost motionless against the plate.

As seen in Figure 1, the lower half of the cassette is covered by a lead strip. There is also a lead screen, *F*, which slides in the tracks, *E*. By manipulating this screen four views can be taken on one film, the cassette being taken out and turned without disturbing the infant. When only two exposures are desired, the screen is pushed to one side.

A groove has been cut in the table top to accommodate the bolt of the thumbscrew, *H*, so that the track and its right angle can be swung to the right or left about a single swivel at the front. By this means rotation films can be obtained with ease. Lateral views are best taken with the track at right angles to the film and turning the child sideways within the padded lead strip.

By means of the handles, *L*, and the wheels, *M*, the apparatus is readily moved from place to place. For greater stability the wheels are not in contact with the floor

FIG. 2

when the machine is in use, the construction being somewhat like that of a wheelbarrow.

The frame is substantially built, simple in operation and we have found the roentgenograms obtained by its use to be more satisfactory than were those with the old technique. When only two views are desired, it is very simple to cut the large size film in half in the darkroom and mount it in the cassette at an end with some kind of characteristic mark on it. The two exposures are then made without the need of turning the cassette by means of the sliding lead screen. We have used the machine* with good results in children up to three years of age.

* The apparatus is made by the George P. Pilling and Son Company, Philadelphia.

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2. MCPHEDRAN, F. M. The diagnosis and classification of pulmonary tuberculosis in childhood and adolescence. *Am. Rev. Tuberc.*, 1929, *20*, 532–636. Also: Roentgenogram in early tuberculosis in adults. *U. S. Nav. M. Bull.*, 1932, *30*, 91–104.

A WET-FILM VIEWING BOX*

By GEORGE LEVENE, M.D., FRANK E. WHEATLEY, M.D. *and* HELEN MATTHEWS, M.S.
BOSTON, MASSACHUSETTS

THIS box was designed principally for the inspection of pyelograms as soon as they are processed, without the usual objections attendant upon the viewing or holding of a dripping film or the interruption of darkroom work.

The box is placed in the darkroom and is fastened by a flange (*P*) to the wall in which a window has been cut. The wet film is viewed from the adjoining room.

The box is made of heavy gauge monel metal and has an outer container (*A*) and a drawer (*B*) which slides in and out on tracks (*C*). The end of the drawer opposite to the handle is open. The drawer is divided into two vertical compartments (*D*) and (*E*) by a sheet of blue "daylight" glass (*F*). It has a cuff (*O*) which fits over the end of the outer container when the drawer is shut and prevents light leaks.

The top of compartment (*D*) is provided

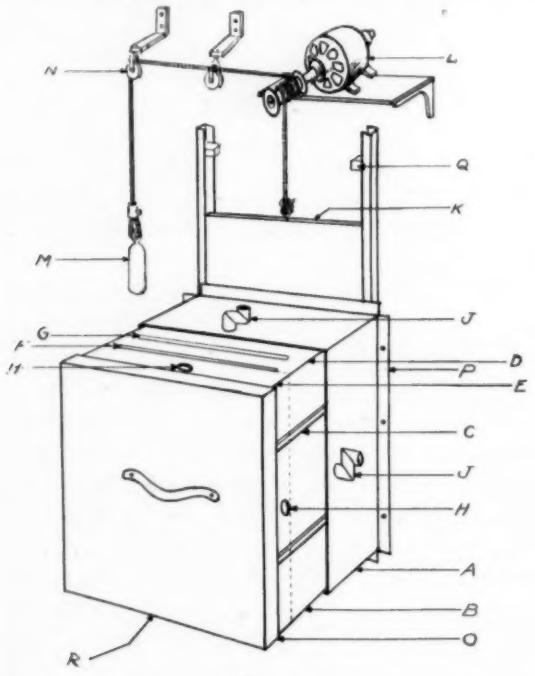

FIG. 1

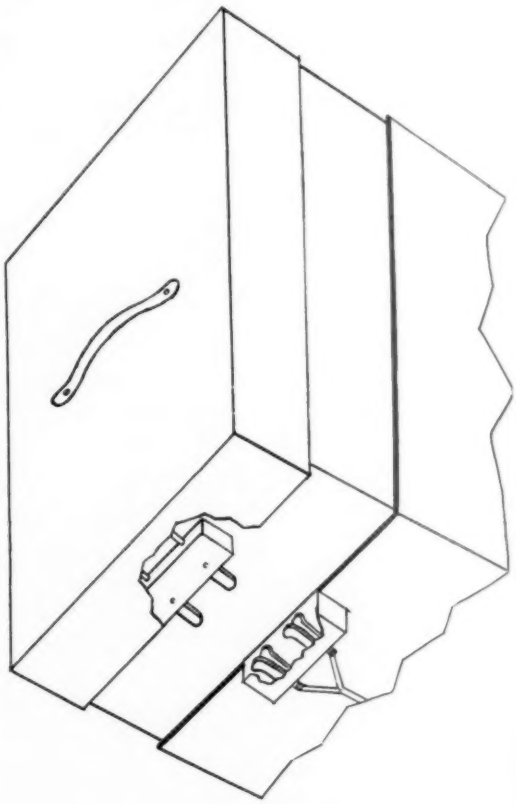

FIG. 2. Detail of switch (*R*).

* From the Department of Roentgenology of the Evans Memorial for Clinical Research and Preventive Medicine of the Massachusetts Memorial Hospitals, Boston.

with a slot (*G*) 15 inches long and 3/4 inch wide to receive a 14″×17″ film in its hanger. The bottom of this compartment has a small trough with an opening which coincides with a similar opening in the outer container when the drawer is shut and from which a piece of lead tubing conducts the drippings to a waste-pipe.

Compartment (*E*) is provided with two 50 and two 100 watt bulbs which are in series with a motor (*L*) and which automatically light by the closing of a switch (*R*) when the drawer is pushed in. Ventilation of this compartment is provided by means of the openings (*H*) which line up with light-proof stacks (*J*) when the drawer is shut.

A panel (*K*) closes the end of the box when the drawer is open, preventing access of light to the darkroom.

When the drawer is shut, the same switch which controls the lights in compartment (*E*) starts the small motor (*L*) which raises the panel and reveals the wet film. The panel is balanced by a counterweight (*M*) suspended from pulleys (*N*). As the panel rises, it strikes a bumper (*Q*) which arrests its further progress and stalls the motor. The latter is a specially wound series motor which will not overheat when stalled. The panel is kept in position by the torque of the motor.

When the drawer is pulled out, the lights go out and the current to the motor is shut off. The panel then slides down by its own weight.

A FOCAL SPOT CAMERA*

By PAUL C. HODGES, PH.D., M.D.
CHICAGO, ILLINOIS

THAT area on the surface of the anode or target of a roentgen tube upon which the stream of cathode electrons is focused is commonly known as the focal spot. Coolidge and Moore[2] have shown that roentgen-ray emission is not limited to this area, the anode head and stem also producing appreciable amounts of radiation. This is true not only in the older types of tubes with solid tungsten anodes but also in tubes in which the anode is a massive block of copper cast about a small button of tungsten only a trifle larger than the focal spot. It is by no means certain that this so-called "stem" radiation does not play a significant rôle in reducing the sharpness of roentgenographic detail and there may even be significance in the evenness of distribution of radiation within the area of the focal spot itself. The fact remains, however, that an overwhelming proportion of the radiation arises in the focal spot and the extent to which this source of radiation approaches a point is an important measure of the ability of any particular tube to produce fine roentgenographic detail.

Effective Focal Spot. With the single exception of that tube in which the anode face is normally parallel with the plane of the film, the focal spots of all roentgen tubes are more or less "astigmatic." In all of the older types, beginning with Jackson's original focus tube[3] and including the universal Coolidge tube, this might be said to be accidental. A cylindrical or conical cathode stream impinging on an oblique target face at an angle of 45° produces an elliptical focal spot. With the tube in its normal working position its anode stem parallel with the plane of the film, the axis of the useful cone of radiation makes an angle of about 45° with the face of the target. The optical characteristics of this radiation are approximately the same as though it had arisen in a circular focal spot parallel with the plane of the film at the height of the center of the target and with a diameter equal to the transverse diameter

* From The Division of Roentgenology, Department of Medicine, University of Chicago.

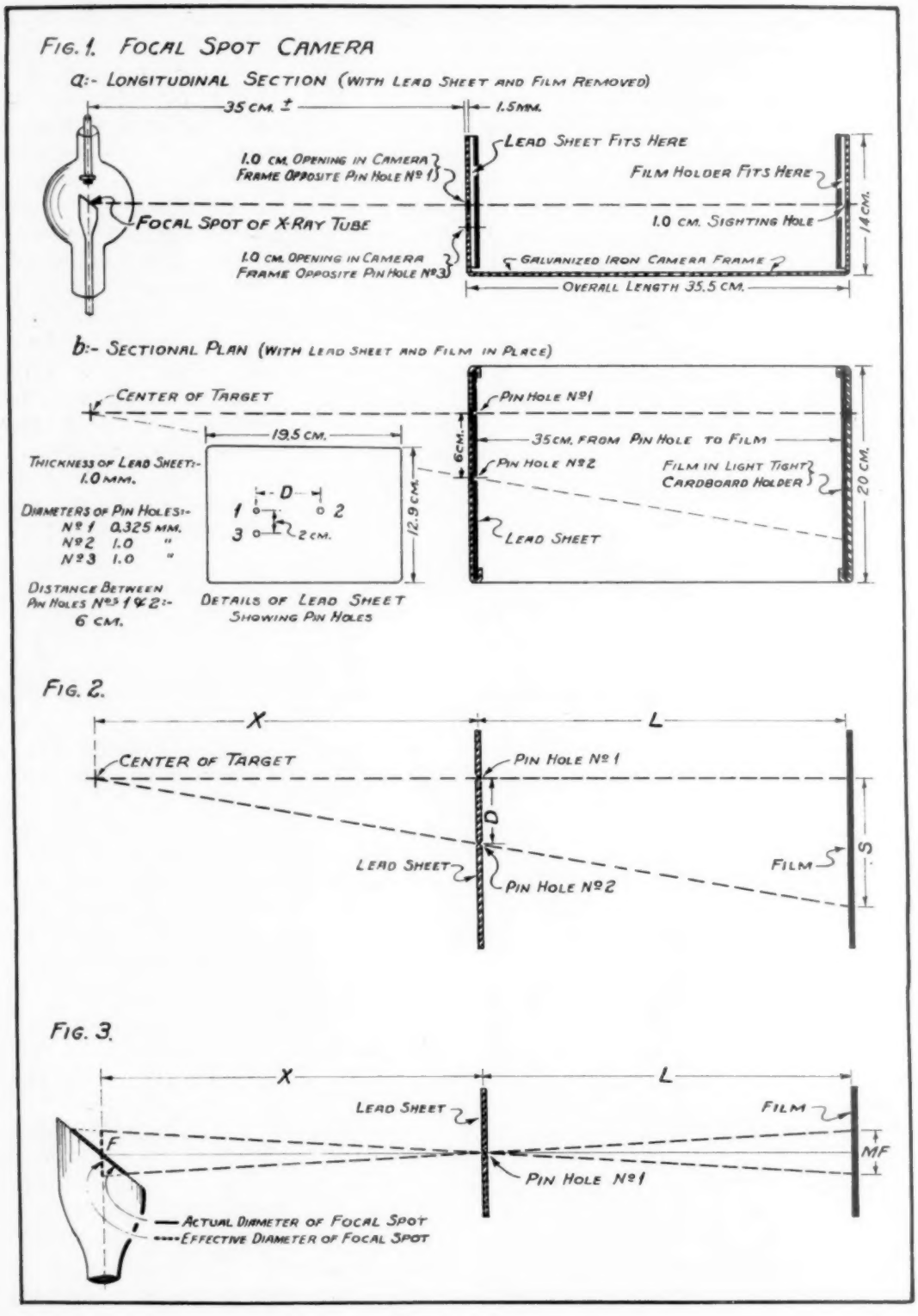
FIG. 1. FOCAL SPOT CAMERA
a:- LONGITUDINAL SECTION (WITH LEAD SHEET AND FILM REMOVED)
35 CM. ±
1.5 MM.
LEAD SHEET FITS HERE
1.0 CM. OPENING IN CAMERA FRAME OPPOSITE PIN HOLE Nº 1
FILM HOLDER FITS HERE
FOCAL SPOT OF X-RAY TUBE
1.0 CM. SIGHTING HOLE
14 CM.
1.0 CM. OPENING IN CAMERA FRAME OPPOSITE PIN HOLE Nº 3
GALVANIZED IRON CAMERA FRAME
OVERALL LENGTH 35.5 CM.
b:- SECTIONAL PLAN (WITH LEAD SHEET AND FILM IN PLACE)
CENTER OF TARGET
PIN HOLE Nº 1
19.5 CM.
6 CM.
35 CM. FROM PIN HOLE TO FILM
THICKNESS OF LEAD SHEET:- 1.0 MM.
PIN HOLE Nº 2
FILM IN LIGHT TIGHT CARDBOARD HOLDER
20 CM.
DIAMETERS OF PIN HOLES:-
Nº 1 0.325 MM.
Nº 2 1.0 "
Nº 3 1.0 "
D
1
2
3
2 CM.
12.9 CM.
LEAD SHEET
DISTANCE BETWEEN PIN HOLES Nºs 1 & 2:- 6 CM.
DETAILS OF LEAD SHEET SHOWING PIN HOLES
FIG. 2.
X
L
CENTER OF TARGET
PIN HOLE Nº 1
D
LEAD SHEET
FILM
S
PIN HOLE Nº 2
FIG. 3.
X
L
LEAD SHEET
FILM
F
MF
PIN HOLE Nº 1
ACTUAL DIAMETER OF FOCAL SPOT
EFFECTIVE DIAMETER OF FOCAL SPOT

FIGS. 1, 2 and 3.

of the elliptical spot on the 45° target.

The effect is deliberate in the so-called line-focus tubes where the actual focal spot is a rectangle several times as long as it is broad. Here the target face makes an angle of about 71° with the normal plane of the film and the optical equivalent or effective focal spot is a square with each of its sides as long as the width of the actual focal spot.

Strictly speaking, the effective focal spots of such inclined target tubes become a trifle smaller in the foreshortened diameter as target-film distance increases and the images produced by them are not quite so sharp as those made by equivalent-size focal spots in tubes with parallel target faces where all of the radiation originates at the same distance from the film. However, under ordinary operating conditions the diameter of the inclined focal spot is so small in comparison with target-film distance that for a given cone of radiation the diameter of the effective focal spot is practically independent of target-film distance, and the distortion of the image that theoretically must ensue from inclination of the target is so slight that it is of no clinical significance whatever.

The diameter of the effective focal spot is, however, of very great practical importance and for many years it has been common practice to measure it by means of pinhole photographs.

Principles of Pinhole Photography. The production of an inverted image of a candle flame by interposing midway between a candle and a white cardboard screen a second piece of cardboard pierced by a pinhole approximately 0.5 mm. in diameter illustrates one of the simplest yet most fundamental principles of optics.[1] If instead of squares of cardboard one substitutes a light-proof cardboard box with a pinhole at one end and a naked photographic plate at the inside of the other end, the image of the flame can be recorded permanently.

When the problem is to make a pinhole photograph of the effective focal spot of a roentgen tube, the anode takes the place of the candle, the pinhole is made in a sheet of lead instead of cardboard and instead of the naked photographic plate one uses a roentgen film in a conventional light-proof cardboard holder. These differences are necessary and possible because the image is to be produced not by ordinary light but by roentgen rays which readily penetrate cardboard but are stopped by lead.

With these simple materials it is possible to make excellent images of the focal spot and in many instances the entire anode as well, but if quantitative information is desired the distances between anode center and pinhole, pinhole and film surface must be measured with great care. When these two distances are equal the diameters of the film image are identical with corresponding diameters on the target, or when the distances are known but not equal, the diameter of the target may be computed from measurements of the image by means of the equation:

$$O = I\left(\frac{X}{L}\right)$$

where

O = any diameter of the object (in this case the focal spot of the roentgen tube)

I = a corresponding diameter on the film image

X = distance from target to pinhole

L = distance from pinhole to film.

Note. Correction for the error produced by the fact that the pinhole has a measurable diameter rather than being a mathematical point is of negligible magnitude for pinhole diameters of the order of 0.5 mm.

Focal Spot Measurements in Cases Where the Distance from Target to Pinhole Cannot Be Measured. Occasionally one wishes to photograph the focal spot of a tube built into a roentgenoscope, contained together with a transformer in an oil-filled tank or mounted in some other fashion that makes it inconvenient or impossible to ascertain the exact location of its target. To meet

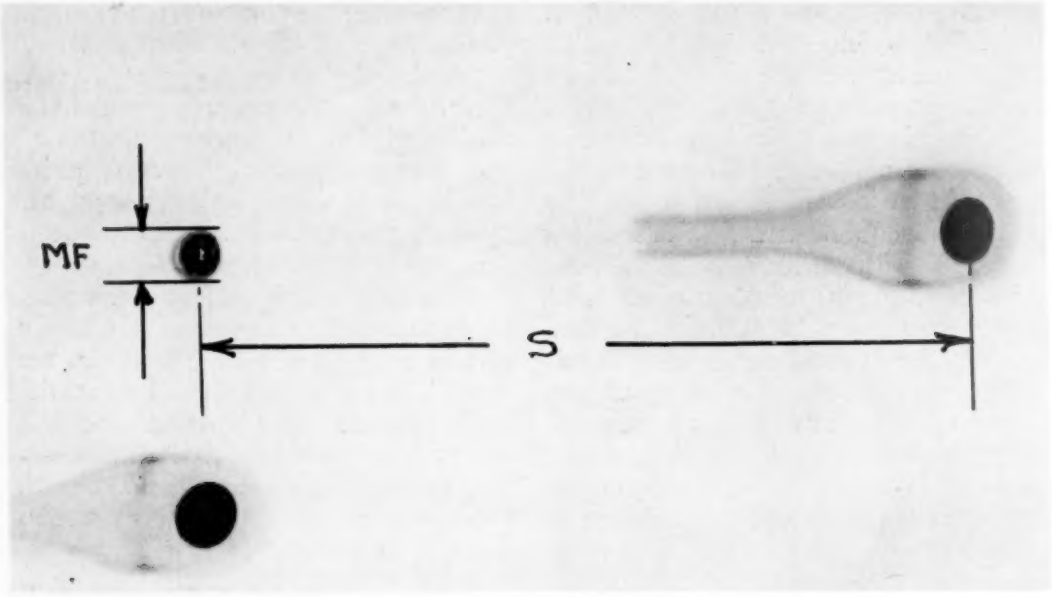

Fig. 4. Medium focus universal Coolidge tube, round effective focal spot. MF=0.8 cm.; S=11.35 cm.; calculated F=0.897 cm. Note: Ectopic emission visualizes target head and stem as well as focal spot.

such situations there has been developed in this laboratory a focal spot camera that does not require accurate measurement of the distance between target and pinhole.

Description of the Camera. A piece of 16-gauge galvanized iron approximately 20 cm. wide by 65 cm. long has its two ends bent up at right angles to the base to form a box open at both sides and at the top (Fig. 1). The edges of the two ends are bent inward to form grooves that receive a lead sheet at the front, a cardboard film holder at the rear. The front end is pierced by three circular openings each 1 cm. in diameter. Two are placed with their centers 6 cm. apart and about 6.5 cm. above the floor of the box. The third lies about 2 cm. below the first opening. The rear end has a single opening directly in line with the first one in the front end. The distance between the two ends of the box is approximately 35.5 cm.

A lead sheet 1 mm. thick fits loosely into the groove at the front of the camera and a 5″×7″ roentgen film in conventional cardboard holder fits into similar grooves at the rear of the camera where it is held parallel with the lead sheet. Three pinholes in the lead sheet line up with the centers of the openings in the front end of the camera. Pinhole No. 1 is made with a watch maker's drill No. 80 and has a diameter of 0.325 mm. (13/1000 in.). Pinholes Nos. 2 and 3 are made with a No. 60 drill and have diameters of 1 mm. (40/1000 in.). The distance between centers of pinholes Nos. 1 and 2 is exactly 6 cm.

Operation. With the aid of a fluoroscopic screen the approximate location of the target of the roentgen tube is determined and a chalk mark is made on the cover of the tube container perpendicularly above or in front of the target, a rough calculation being made as to the approximate distance between target and chalk mark. The camera is set up so that the distance from the front of the camera to the supposed location of the target is approximately 35 cm. The instrument is then maneuvered until the operator sighting through the rear opening sees the chalk mark in line with the center of opening No. 1. When this alinement is satisfactory the lead sheet and roentgen film holder are inserted in their respective grooves and an exposure is made.

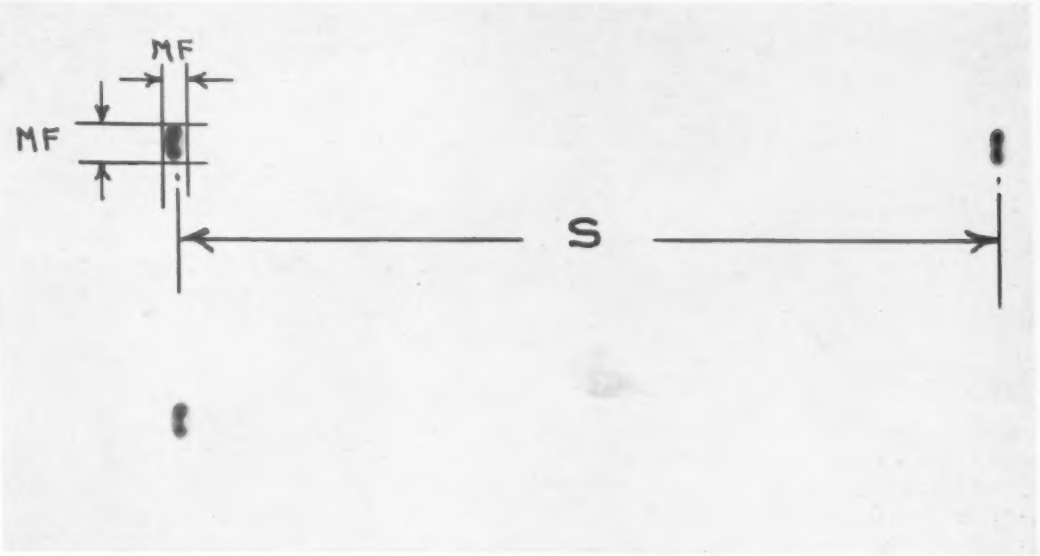

Fig. 5. Oil-immersed dental tube; elliptical effective focal spot. MF = 0.3 cm. × 0.5 cm.; S = 10.7 cm.; calculated F = 0.38 cm. × 0.638 cm.

Note. The principal pinhole is so small that it is necessary to remove the lead sheet during the alinement of the camera. In replacing the lead in its grooves it is, of course, important to be sure that it lies in the proper relationship to the holes through the front end of the camera—that is, that each of the pinholes lies behind a larger hole in the sheet metal in front of it.

Interpretation of Films. A film made in this manner shows three pinhole images of the focal spot (Figs. 2 and 4). The first one, designated the "principal image," is smaller and sharper than the others because being produced by the very small pinhole No. 1 it is practically devoid of halo. Inspection of the film will leave little doubt as to which image is the principal one but to make identification complete the third pinhole has been added. It lies directly below the principal pinhole. The theory of formation of this principal image (MF) is illustrated in Figure 3.

The second image lies with its center separated from the center of the principal image by a distance S. S is exactly 12 cm. if X and L are exactly equal and is less than 12 cm. if X is larger than L.

By triangular proportion it is obvious that in Figure 2

$$\frac{X}{D}=\frac{X+L}{S}$$

which may be simplified as follows:

$$SX = DX + DL$$
$$SX - DX = DL$$
$$X(S - D) = DL.$$

This reads finally:

$$X=\frac{DL}{S-D}$$

where

X = distance from target to pinhole in centimeters

L = distance from pinhole to film in centimeters

D = distance between centers of pinholes Nos. 1 and 2 in the lead sheet (in this particular case 6 cm.)

S = distance in cm. between centers of images of pinholes Nos. 1 and 2 (called the spread).

In Figure 3

$$\frac{MF}{L}=\frac{F}{X}$$

Fig. 6. WXP3 Coolidge tube; rectangular effective focal spot. MF =0.25 cm. ×0.35 cm., S = 11.05 cm., calculated F =0.297 cm. ×0.415 cm.

so

$$F = \frac{MF \times X}{L}.$$

The X and L of Figure 3 are identical with the X and L of Figure 2 and from Figure 2 it was deduced that:

$$X = \frac{DL}{S - D}.$$

Substituting this value in the equation from Figure 3 we obtain

$$F = \frac{MF\left(\frac{DL}{S-D}\right)}{L}.$$

This may be simplified to read

$$F = \frac{L\left(\frac{MF \times D}{S-D}\right)}{L}$$

and finally

$$F = \frac{MF \times D}{S - D}.$$

In this particular case D is known to be exactly 6 cm. so the equation becomes

$$F = \frac{MF \times 6}{S - 6}.$$

This may be read: The true diameter of the focal spot is equal to the diameter of its principal image in centimeters multiplied by 6, divided by the spread between images Nos. 1 and 2 measured in centimeters, minus 6 cm.

Practical Application of the Method. While the camera was developed primarily for use in those cases where the roentgen tube is shut away from view, it may be used for all kinds of focal spot filming. Where the tube is mounted in a conventional tube stand it should be turned until the axis of the cone of radiation is parallel with the floor and the aluminum filter should be removed. The camera is then supported on some convenient piece of furniture, the filament is lighted, and the observer sights through the camera directly on to the illuminated surface of the target.

If the tube is in a horizontal roentgenoscope, it should be locked in a fixed position and a chalk mark made on the table

top perpendicularly above the center of the target. The camera is then turned on end with opening No. 1 of the front end resting on the chalk mark.

For tubes centered above a table the camera rests with its film end on the table top. With the help of a plumb bob, tube and camera are adjusted until pinhole No. 1 is approximately on a perpendicular dropped from the focal spot.

Freedom from Error. The absolute size of a focal spot image to some extent depends upon the voltage applied to the tube, the total intensity of the radiation and the type of film and screen used. These are, however, matters beyond the scope of the present publication.

The camera itself is practically immune to technical errors. If the distance from the target to the pinhole is very much greater than 35 cm., the distance S may be much less than 12 and the accuracy of the computation therefore may be decreased; or if the distance from the target to the pinhole is much less than 35 cm., S may be so long that the image of the second pinhole is thrown off the film entirely. In the latter case it is possible to make the computation by using the distance between the centers of pinholes Nos. 1 and 3 as D and the distance between their images as S. It is better, however, to discard such films and move the camera a little farther away from the tube for another exposure.

It is desirable to line up the camera so that the radiation travelling from the target through pinhole No. 1 on through the sighting hole in the rear lies approximately along the axis of the cone of emergent radiation. If this alinement is carelessly done, the edge of the cone may be silhouetted across the film and the image of the second pinhole lost. It should be noted, however, that the geometric derivation of the equation does not rest on the assumption that the triangles of Figures 2 and 3 are right triangles. An extreme degree of obliquity of radiation may make it impossible to make a measurement at all but if the pinhole images can be seen on the film the measurement can be made regardless of obliquity.

While it is a simple matter to measure the distance from the pinhole to the film, this measurement does not enter into the computation. There is an advantage in this fact because if the source of radiation is weak and one prefers to use a film in a cassette between intensifying screens he may do so, placing the cassette in front of the grooves intended for the cardboard holder and holding it in place there with stout rubber bands. This increases the distance from pinhole to film, decreases the diameter of MF, but compensates for this by automatically decreasing S in the same ratio.

If the lead sheet or the film be bent slightly forward or backward—in other words, if either end of the camera be out of its perpendicular relationship to the base—no harm is done. Obviously one would not use a camera that had suffered such an accident but the knowledge that this is true makes it clear that trivial errors occurring at the time the camera is built do not affect the validity of measurements made with it.

RÉSUMÉ

1. By means of a pinhole camera having two apertures instead of one, it is possible to calculate the diameter of the effective focal spot (F) of a roentgen tube in cases where the distances from focal spot to pinhole and pinhole to film are unknown.

2. The equation reads:

$$F = \frac{MF \times D}{S - D}.$$

3. MF, the diameter of the principal focal spot image, and S, the distance between centers of the two images, may be measured directly on the film. D, the distance between apertures, is fixed when the camera is built. In this particular instrument the value of D is 6 cm.

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

Cushing, Harvey. The basophil adenomas of the pituitary body and their clinical manifestations (pituitary basophilism). *Bull. Johns Hopkins Hosp.*, March, 1932, *50*, 137–195.

Twelve cases are presented in considerable detail, including cases from the literature and from the author's practice. The patients were young, the average age being only eighteen years, and were undersized, with two exceptions among the males. The average duration of the disease was about five years. All showed: (1) a rapidly acquired painful adiposity confined to face, neck and trunk; (2) kyphosis; (3) sexual dystrophy with either amenorrhea or impotence; (4) abnormal hirsutes; (5) dusky skin with purplish atrophic striae; (6) hypertension; (7) erythremia; (8) variable backaches, abdominal pains and weakness. Occasional findings were: (1) purpura-like ecchymoses; (2) variable eye symptoms and pathologic changes; (3) dry, pigmented skin; (4) polydipsia and polyuria; (5) edema; (6) albuminuria; (7) insomnia. Blood chemistry was altered and a leucocytosis was present in some cases. Death occurred usually from intercurrent infections apparently due to increased susceptibility. Post-mortem examination revealed an osteoporosis of the skeleton. In 3 cases basophilic pituitary adenomas were found at necropsy. Undifferentiated adenomas were found in 3 other cases. Variable changes were described in connection with the other ductless glands.

Primary anterior pituitary disorders are commonly produced by adenomas. Adenomas are functionally active and even minute adenomas may cause serious derangements. Pituitary adenomas are of three types: neutrophilic, acidophilic and basophilic, to the last of which, a definite constitutional disorder has not heretofore been ascribed. The finding of 6 cases with anterior pituitary adenomas in a group of 12 with a peculiar polyglandular syndrome is very significant. Pathologists should more carefully scrutinize the anterior pituitary lobe for similar lesions.—*E. W. Hall.*

Cushing, Harvey. Further notes on pituitary basophilism. *J. Am. M. Ass.*, July 23, 1932, *99*, 281–284.

The syndrome published in a previous paper and ascribed to pituitary basophilism is not an uncommon one. Numerous cases have been reported in which the disease has been ascribed to a primary adrenal disorder because of the frequent post-mortem finding of cortical hyperplasia. The pituitary has not been closely examined and careful serial study of the complete anterior lobe is necessary before basophil adenoma can be ruled out. Further evidence has been adduced confirming the provisional diagnosis of pituitary basophilism in some of the 12 cases previously presented and further cases are added. Further study is needed regarding the bearing of basophilism on vascular hypertension. A patient under observation at the present time with long-standing, so-called essential hypertension has deen definitely benefited by irradiation of the pituitary body.—*E. W. Hall.*

Thompson, Charles F., and Reed, Jewett V. Traumatic pneumocephalus. *J. Am. M. Ass.*, March 19, 1932, *98*, 981–983.

A case of traumatic pneumocephalus is added to 7 previously reported in the literature. Intracranial infection complicating a fistula occurred in only 2 of the cases and most of them closed spontaneously. Air is admitted through compound fractures of the cranial vault or fractures into the cranial air sinuses. A ball valve action of a bone fragment or an inverted bottle effect by air passing from the sinuses and fluid coming out may cause air to enter repeatedly. If the rate of entry exceeds that of absorption the pneumocephalus may persist for several months. Surgical closure should be resorted to after little delay as delay entails needless risk.—*E. W. Hall.*

v. Eiselberg, A. Ueber einen Fall von posttraumatischer Liquorfistel und ihre röntgenologische Darstellung. (A case of post-

traumatic cerebrospinal fluid fistula demonstrated roentgenologically.) *Acta chir. Scandinav.*, 1932, *71*, 205–211.

The author describes the case of a woman aged twenty-four who had a fracture of the left temporal and frontal bones with a lesion of the brain and sagittal sinus. Eight days after operation there developed a suppurating fistula. A second operation three weeks after the first showed no abscess but very soft brain substance. The fistula became so large that it corresponded almost to the left lateral ventricle. By heavy iodoil the connection between the fistula and the ventricle could be visualized. The patient lived for several weeks with a continued secretion of fluid through this fistula. The roentgen findings seem to support the view that the intraventricular foramen of Monro had become obstructed by the inflammatory reaction in the brain because the impouring of the oil revealed almost the whole of the left lateral ventricle, while in the third ventricle only traces of the contrast fluid could be seen and in the right lateral ventricle none at all. The findings are illustrated by four reproductions of roentgenograms.—*E. T. Leddy.*

NECK AND CHEST

Goldmark, Carl, and Scholz, Thomas. Diverticulum of the epiglottic valleculae. *J. Am. M. Ass.*, June 4, 1932, *98*, 1972–1974.

Pre-epiglottic diverticulum is a rare condition produced by a loss of elasticity of the loose tissue beneath the epiglottic valleculae, or some interference with the mechanism of swallowing as in vagus or recurrens paralysis. Food retention within the valleculae has been described, but pre-epiglottic diverticulum has apparently not heretofore been reported. Two cases are presented in which there was a sensation of food retention after eating, discomfort on swallowing, occasional regurgitation of foul material, swelling, and local tenderness. Roentgen study revealed a fullness in the pre-epiglottic region and retention of barium for several hours. For diagnosis observation must be prolonged.—*E. W. Hall.*

MacMillan, A. S. Pouches of the pharynx and esophagus. *J. Am. M. Ass.*, March 19, 1932, *98*, 964–969.

A careful examination of 1000 cases of dysphagia showed pharyngeal pouches to be the cause in about 2 per cent and esophageal pouches in 1 per cent. The average age of occurrence of Zenker's pulsion diverticulum was sixty-three years and of 18 cases here presented 14 were males. Symptoms are not characteristic and cannot be differentiated from those of neoplasm. The roentgen study with barium paste is the only correct diagnostic means in pharyngeal or esophageal diverticula.

Surgical removal of Zenker's diverticulum is a delicate operation usually done in two stages with satisfactory results. Surgery of esophageal diverticula presents considerable difficulty as in all esophageal surgery.—*E. W. Hall.*

Brdiczka, I. G., and Tschakert, J. Die röntgenologische Diagnostik der Ösophagusvarizen. (The roentgen diagnosis of varices of the esophagus.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Aug., 1932, *46*, 156–166.

The authors present a detailed discussion of the anatomy of the venous blood supply of the esophagus and they point out that varices are commonest in the lower portion of the esophagus in cirrhosis of the liver. The authors prefer to use a thick barium mixture to detect deformity of the esophagus, and roentgenograms are made at expiration. The characteristic string of pearls sign is the most important criterion for the diagnosis. The authors report that in the severest cases there is almost always a thrombosis of the portal vein.—*E. T. Leddy.*

Van Leeuwen, W. S., and Weltz, G. A. Über die Zwerchfallfalten im Röntgenbild. (Defects of the diaphragm seen in roentgenograms.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Aug., 1932, *46*, 167–174.

The authors found defects in the diaphragm in a large percentage of asthmatic subjects. These defects may be produced by stimulation of the phrenic nerves which produces an excessive tonus of the diaphragm. At the same time the ribs are raised by expansion of the thorax. Normal persons show no defects during deep inspiration. But if the body is protruded at the same time, more or less marked defects are produced. The diaphragm is then situated more deeply and the angle of the ribs is decreased. These defects are common in singers during deep inspiration. By drawing in the abdomen folds are produced. The frequency of these defects in asthmatics leads the authors to think that in them during deep inspiration the dia-

phragm is situated lower than usual and the length of the thorax is much greater than in the normal person so that the angle of the ribs is narrower than normal.—*E. T. Leddy.*

McMahon, B. T. Spontaneous bilateral pneumothorax. *Am. J. M. Sc.*, 1932, *183*, 695.

When the patient, a man aged twenty-seven, was admitted, roentgenoscopic examination revealed the left lung to be about 50 per cent collapsed and a small amount of fluid in the costophrenic sulcus. The heart and mediastinum were slightly displaced to the right. No evidence of gross disease of the lung was seen. Stereoscopic films showed that the markings of the right lung were intensified and that there was a hydropneumothorax on the left. The left lung was about 50 per cent collapsed and free of adhesions or gross disease. A month later the patient became unusually dyspneic and roentgenoscopic examination revealed a right-sided pneumothorax with about 60 per cent of collapse. Recovery followed. As no cause for the condition could be discovered, the case was regarded as one of idiopathic bilateral pneumothorax, the rupture of the second lung taking place before reëxpansion of the first was effected. Similar cases are cited from the literature.—*Albert Miller.*

Bouslog, John S., and Wasson, W. Walter. Hodgkin's disease with cavity formation in the lung. *Arch. Int. Med.*, 1932, *49*, 589–598.

The patient, a man aged twenty-eight, was seen first in 1924. At that time he had definite Hodgkin's disease involving especially the lymph nodes of the neck, axillae and groin, and roentgen examination revealed a large lobulated mass in the mediastinum. Under roentgen therapy the masses were reduced and symptoms relieved. In 1928 a roentgenogram showed a small cavity in the mass extending from the right hilum toward the apex. The cavity increased progressively in size. At necropsy a few months later there was a nodule in the right upper lobe, measuring 5 cm., also a cavity 2 cm. below the apex which measured approximately 6 cm. in diameter. It was free from exudate: the lining was nodular and covered by a smooth membrane. The anatomic diagnosis was lymphogranulomatosis of the lung with cavity formation. The writers were unable to find a similar case reported in the literature.—*Albert Miller.*

Sowerbutts, Joseph. Significance of "annular shadows" in radiograms of the chest. *Lancet*, 1932, *2*, 623–624.

In the past, various theories have been advanced to account for annular shadows. The shadows have been ascribed to air pockets in the pleura in the region of the fissures, to localized pneumothoraces, to circular adhesions of the parietal and visceral pleura, and to tuberculous cavities. In 1930 Mitchell suggested that their origin was as follows: A small bronchus or bronchiole, weakened by disease and strained by coughing, becomes perforated and allows air to escape into the connective tissue of the lung. It does not become an interstitial emphysema but a single bubble of air. Sowerbutts observed an instance in a girl aged eighteen who had extensive tuberculosis in the upper portion of the right lung. Following artificial pneumothorax, an annular shadow developed quickly in the collapsed lung. The shadow changed position as that of the lung changed, could be seen in both the anterolateral and oblique views, and the air pocket caused bulging of the edge of the lungs in the anteroposterior film. Sowerbutts regards the case as supporting Mitchell's theory.—*Albert Miller.*

Hartung, Adolph, and Freedman, John. Pulmonary syphilis: a report of three cases of acquired lung syphilis in adults, with particular reference to roentgen aspects. *J. Am. M. Ass.*, June 4, 1932, *98*, 1969–1972.

Carrera found pulmonary syphilis in 12 of 152 cases of known syphilis at post-mortem examination. Erickson found 23 of 240 autopsies on known syphilitics to show pulmonary syphilis but the incidence in 29,680 routine autopsies was only 0.06 per cent.

Lung syphillis is never primary. In early cases it responds to adequate therapy but if untreated is slowly progressive. Improvement under antisyphilitic treatment is contributory evidence as to the nature of pulmonary lesions but by no means absolute, as syphilitic lesions are often more intractable than other spirochetal infections of the lungs. Other aids in diagnosis are: (1) history; (2) symptoms and signs of a marked progressive lesion with signs much greater than symptoms; (3) demonstration of *Spirochaeta pallida* (very rarely accomplished); (4) serologic examinations; (5) roentgen examinations revealing chronic pulmonary disease of the root, middle lobe or base of the

lung in which tuberculosis has been ruled out. Anatomic confirmation is the only final test.

No dogmatic statements in regard to the roentgen appearance of pulmonary syphilis can be accepted as the same shadows might be produced by a variety of conditions. Gummas may be nodular or diffuse. In late stages there is usually marked consolidation due to fibrosis, bronchostenosis and collapse and there is invariably bronchiectasis. They rarely undergo cavitation and healing occurs without calcification. Successive roentgen examinations are of great importance in diagnosis.

The authors report 3 interesting cases, only one of which came to autopsy.—*E. W. Hall.*

Unshelm, E. Zystische Gebilde im Brustraum des Kindes. (Cystic appearances in the juvenile thorax.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, July, 1932, *46*, 1–14.

The author describes 2 cases of intrathoracic cysts in children. In the first child, aged four, a cyst developed in the upper left lobe after pneumonia. The cyst enlarged rapidly in the course of three months. By injection of iodipin into the cavity it was shown to have a valve-like communication with the bronchial tree. In the course of a few years the cyst became smaller. The author considers this a case of post-empyemic valved pneumocyst. The other child, aged five, had a cyst in the posterior upper region of the right lung of seventeen months' duration. Peroral injection of iodipin showed communication with the bronchial tree. The size of the cyst varied from time to time. There was a fluid level in the lower part of the cyst. This child, unlike the first who had no symptoms, suffered from attacks of acute bronchiectasis with fever and expectoration of a large quantity of sputum. The author considers this to be a case of congenital large solitary bronchiectic cavity, that is, a bronchial cyst. The author also enumerates the most important cysts occurring in the thorax of children.—*E. T. Leddy.*

Martin, Ann. Tuberculous pulmonary infiltrations in childhood. *Am. J. Dis. Child.*, Oct., 1932, *44*, 754–769.

Sixty cases of tuberculous primary infiltration are reported. They are divided into three clinical groups according to their symptom-complex: (1) children with acute tuberculous pneumonia; (2) children who were not well, but who showed no evidence of an acute illness, and (3) children in good health. Eighty per cent of the cases with pulmonary infiltrations occurred in children under six years of age.

The author finds that tuberculous infiltrations in the lungs are characterized by their chronicity, as demonstrated by serial roentgenograms. In this respect they can usually be differentiated from non-tuberculous infiltrations. She regards serial roentgenograms as absolutely necessary in the study and care of juvenile tuberculosis.

The infiltrations found in the roentgenograms in these cases were in various parts of the lungs. They were circumscribed or involved a large area. The density varied greatly. From the roentgenogram alone, it was impossible to determine in which group individual lesions belonged. In general, in group 1, the lesions were more extensive and showed a greater degree of density than those of groups 2 and 3. In group 1, also, cavities developed in two cases but later disappeared. Involvements of the pleura were also more frequent in group 1. Shadows that overlie the hilar area can be shown to be in the parenchyma of the lung, lying either anterior or posterior to the hilus by using the oblique views advocated by McPhedran. This type of lesion cleared very slowly, as shown by serial films taken at intervals of a few months, and carried over a period of several years. As the infiltration cleared, strands of fibrosis were often seen, which later disappeared. The clearing proceeded from the periphery toward the hilus. Often as clearing proceeded, a central dense area emerged that went on to calcification and the formation of a primary focus. The majority of cases, however, cleared completely by resolution, leaving no evidence of calcification in the parenchyma or the hilar glands. Calcification in the hilar glands may appear late, as healing and calcification proceed very slowly. In some early cases, calcification appeared in the hilar glands after three years. Pressure of an enlarged node on a bronchus or a plug of mucus may cause atelectasis as shown by the density of the shadow, the elevation of the diaphragm and the displacement of the heart and mediastinum to the affected side. Roentgen evidence of enlarged tracheobronchial lymph glands is frequently associated with the pulmonary infiltrations. Such enlarged glands may not be visible at all times in the

course of the disease, being obscured by the overlying infiltration.

Physical signs, except in the acute stage of tuberculous bronchopneumonias, are of little help in determining the presence of a tuberculous infiltration in the lungs of children. All children with pulmonary infiltrations had positive intradermal reactions, and a history of contact was present in 65 per cent of the cases studied. In a very large number of cases chronic infections of the upper respiratory tract were present and in selected cases a tonsillectomy was indicated.

In regard to diagnosis, the author states that pneumonias in which there is a positive intradermal reaction must be considered tuberculous until proved otherwise, if the roentgen evidence of pulmonary infiltration persists after the clinical illness subsides. The presence in the roentgenogram of large, tracheobronchial lymph nodes is strong evidence that the infiltration is tuberculous. A history of known exposure to tuberculosis is added evidence. In tuberculous pneumonias the patient is not as toxic as in other pneumonias. Examination of the sputum secured by gastric lavage often gives conclusive evidence of the tuberculous origin of the pneumonia. In the unresolved pneumonias and so-called fibroid lungs, râles are numerous and persistent. They are often absent in the later stages of a tuberculous infiltration.

Acute tuberculous pneumonias are more frequent than is generally recognized. Martin believes that they have a good prognosis if seen early, and if repeated infection is prevented by separation of the child from the source of infection.—*R. S. Bromer.*

Jacobaeus, H. C., and Westermark, Nils. Contribution to the interpretation of localized roentgen opacities in the neighbourhood of the interlobar fissures of the lung. *Acta chir. Scandinav.*, 1932, *71*, 494–516.

Localized shadows in the roentgenogram seen close to the interlobar fissures of the lung are generally regarded as interlobar exudates or marginal infiltrations in the lung. The authors present 9 cases of this type studied roentgenographically which led them to conclude (1) that in none of the cases was there an interlobar exudate, and (2) that in all the cases more or less marked symptoms of partial massive collapse had been present. In some cases these symptoms predominate, in others there are simultaneous signs of more or less marked parenchymatous infiltrations of varying etiology and probably varying histologic structure, a condition well described as "marginal infiltration." This view is important both from a diagnostic and a therapeutic point of view. In pulmonary tuberculosis, especially where such changes are common, the roentgenographic findings may be of great importance in determining the correct treatment.—*E. T. Leddy.*

Keller, A. E., Hillstrom, H. T., and Gass, R. S. The lungs of children with ascaris; a roentgenologic study. *J. Am. M. Ass.*, Oct. 8, 1932, *99*, 1249–1251.

It is well known that the development of *Ascaris lumbricoides* does not occur directly after embryonate forms are swallowed. The larvae escape from the eggs, penetrate the intestinal mucosa, and are carried through the liver to the heart and lungs.

A roentgenologic study of the chests of a group of 80 ascaris positive children with negative tuberculin tests showed increase in hilus and bronchovascular markings of the type usually considered tuberculous. The changes seen are the end-result of inflammatory processes set up by the migrating ascaris larvae. The findings were controlled by a group of 40 children who were ascaris free as well as negative by tuberculin test.

The knowledge of these changes is important in evaluating hilus and peribronchial fibrosis, especially when there is no response to tuberculin tests.—*E. W. Hall.*

Pierson, John W. Pneumonia due to the aspiration of lipoids. *J. Am. M. Ass.*, Oct. 1, 1932, *99*, 1163–1165.

Oils, extensively used in pediatric practice for food and therapeutic purposes, readily pass from the nasopharynx to the alveoli of the lungs and produce unexpected pulmonary complications. There occurs fibrosis and giant cell formation due to the slow excretion of the lipoids upon which an acute pneumonic process may be superimposed. Phagocytes appear within a few minutes after introduction of the oil and after incorporating as much as possible they pass into the lymphatics and clog the lymph channels.

The roentgenogram reveals large areas near the hila showing consolidation of low density

and containing considerable fibrosis. When an acute pneumonia is superimposed the picture is not unlike that seen in tuberculosis. Only serial films, carefully studied in the light of the patient's history, can establish the diagnosis. Pneumonia is an infrequent complication and seems to follow repeated use rather than single injections, being unusual after the use of diagnostic iodized oil.—*E. W. Hall.*

Fetzer, Hans. Die Lage des rechten Vorhofes und des rechten Ventrikels beim stehenden Menschen. (The position of the right auricle and right ventricle in the erect human subject.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, July, 1932, *46*, 29–36.

The author showed by Stumpf's roentgen kymographic method that the right border of the heart is partly formed by the right ventricle. This border is extended so that it crosses to the right of the median line. The anterior wall of the right ventricle lies partially anterior to the descending vena cava. With the superficial kymogram purely ventricular movement as well as auricular pulsation may be observed.—*E. T. Leddy.*

Popp, L. Über die Herzgeschwülste in Verbindung mit einem Falle von Sarkom des rechten Vorhofohres. (Tumors of the heart with special reference to a case of sarcoma of the right auricle.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, July, 1932, *46*, 23–28.

Popp writes a detailed review of the literature on tumors of the heart and reports a case of his own, the first to be published on the roentgen study of myocardial tumors. His case, a sarcoma of the wall of the right auricle (controlled by post-mortem examination) occurred in a man of thirty-three and was temporarily improved by roentgen therapy. The author feels that any rapid increase of a cardiac dimension by roentgenography, particularly in the absence of pulsation of the enlarged area (due to infiltration of the heart wall by tumor), probably indicates a myocardial tumor. —*E. T. Leddy.*

Holzmann, Max. Röntgenbefunde bei Trikuspidalfehlern. (Roentgen findings in tricuspid disease.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, July, 1932, *46*, 14–22.

After a review of the roentgen signs of tricuspid disease, the author reports 2 cases showing a new and rare roentgen appearance. In the first case there was a large shadow passing laterally upward across the aortic arch in the left mediastinum which showed a pulsation at ventricular systole which was due to tricuspid insufficiency resulting from a greatly enlarged left vena anonyma. In the second case there was observed at the right diaphragmatic dome a double-waved liver pulsation due to a marked regurgitation into the liver due to powerful action of the right auricle. This finding may be due to either tricuspid disease or other lesions which may cause regurgitation.—*E. T. Leddy.*

Determann, A. Beitrag zur Differential diagnose der Verschattungen in der Herzsilhouette. (A contribution to the differential diagnosis of shadows within the cardiac silhouette.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Aug., 1932, *46*, 137–142.

The author describes a case of cardiac aneurysm and calcification of the cardiac wall ("armored heart," Panzerherz) and discusses the roentgenologic differential diagnosis of the lesion. In cardiac aneurysm, in addition to a circumscribed bowing of the wall having a well defined sharp contour, a homogeneous shadow should also be seen. This shadow does not necessarily lie in any particular direction with reference to the periphery of the heart. They are usually situated in the region of the left ventricle or near the apex. Armored heart which is the final stage of pericarditis calculosa, has typically an irregular border of its shadow and is situated usually at the under side of the heart shadow and in advanced cases surrounds the whole heart like a belt. Determann points out that shadows which, as a result of faulty projection, may appear to be in the periphery of the heart, may be confused with those originating from a true pericarditis calculosa.—*E. T. Leddy.*

Jäderholm, K. Bruno. Über Perikarddivertikel. (Diverticula of the pericardium.) *Acta chir. Scandinav.*, 1932, *71*, 517–523.

The author describes and illustrates by reproductions of roentgenograms a case with a peculiar massive abnormal shadow in the mediastinum. As the patient had the signs described by Kienböck and Weiss and G. Jansson, a diagnosis was made of pericardiac diverticulum. Since the findings were unchanged two months

later the author feels his diagnosis was supported. He reports a second case which at autopsy proved to be a pericardiac diverticulum, but which had been diagnosed roentgenologically as encapsulated interlobar exudate.—*E. T. Leddy.*

Edeiken, Joseph, and Wolferth, Charles C. The heart in funnel chest. *Am. J. M. Sc.*, 1932, *184*, 445–452.

Ten cases of moderate or severe funnel chest were studied in order to determine its effect on the heart. There were 9 males and 1 female, and ages ranged from seven months to sixty-nine years. The deformity was probably acquired in 4 cases, in 5 congenital, and in 1 unknown. On roentgenoscopic examination it will be found that the heart in cases with moderate or marked deformity tends to be displaced to the left and upward, the amount of displacement varying with the shape and situation of the deformity. The heart is enlarged in its transverse diameter, but the anteroposterior diameter is decreased. Electrocardiograms fail to reveal any consistent deviation of the electrical axis. Uncomplicated funnel chest does not appear to have any clearly defined effect on the functional rapacity of the heart unless the deformity is traumatic or of rapid development.—*Albert Miller.*

Blackford, L. Minor, Davenport, Tom F., and Bayley, Robert H. Right aortic arch. I. Clinical report of a case with associated anomalies. *Am. J. Dis. Child.*, Oct., 1932, *44*, 823–844.

The authors report a case of right aortic arch in a boy aged ten who has been under their care since infancy. In May, 1931, the roentgen findings were as follows: roentgenoscopically, pulsation of the aortic knob was visible at the right of the sternum, and there was some pulsation in the region of the conus arteriosus. Pulsation of the pulmonary arteries at the hila was not observed; in the teleroentgenogram, slight enlargement of the left ventricle and increased width of the ascending aorta, which was largely to the right of the midline, were noted. In addition to the knob on the right, the aorta showed a slight bulge to the left at the same level. When the anteroposterior plate was made with the esophagus visualized, this bulge to the left could be made out beyond the esophagus. In the diagonal views, the aorta was seen arching over the right bronchus.

Physical examination showed moderate cyanosis and marked clubbing. The retinal veins were rather full and darker than normal, and the outlines of the optic disks somewhat blurred. Pulsation was visible and palpable, lateral to the clavicular insertion of the sternocleidomastoid muscle and in the first and second interspaces just to the right of the sternum, greater in the second. The second sound was more pronounced in the second interspace than in the first. The murmur seemed to be the "machinery murmur," and was also loudest in the second right interspace. This murmur was even louder in systole in the right interscapular space at the level of the fourth dorsal vertebra and was transmitted directly downward

Later roentgenographic studies revealed the aortic knob as in the first mentioned, pushed to the right with a bulge on the left, at the same level. In another roentgenogram the esophagus was visualized with barium sulphate, and was seen sharply pushed to the left at the level of the arch. Also a projection to the left of the esophagus was noted on close observation, that could only be interpreted as the diverticulum that represents the distal root of the left dorsal aorta. In other careful studies in the oblique diameters, evidence was found that was believed to be due to the ductus pulling forward the esophagus. After still more careful studies, a shadow was detected that was thought to be due to the retro-esophageal diverticulum that Arkin emphasized, an oval shadow lying in the arch of the aorta just above the right bronchus, between the vertebral column and the trachea.

In their summary, the authors state that shortly after the 13 mm. stage, the left dorsal aorta or the left aortic arch may be obliterated. If this occurs in a considerable segment before the atrophy of the distal part of the right dorsal aorta, the right dorsal aorta remains patent on account of the force of the blood stream. If the right aorta has disappeared and the atresia is sharply localized just distal to the mouth of the ductus arteriosus, coarctation of the aorta (adult type) results. For reasons that cannot be explained on either etiologic or physical grounds at this time, occasionally there is an arrest of embryologic processes resulting in persistence of both aortic arches. There have been reported approximately 100 cases of right aortic arch: some alone, some with an obliterated left

arch and some with a patent left arch. If there is an associated lesion, such abnormal development is not likely to impair the health or longevity of its subject. It is possible to make an absolute diagnosis of right aortic arch in life, but it does not seem possible to exclude persistence of a vestige of the left arch.

In their case, they think the aorta is unusually wide at its origin probably because it receives blood from both ventricles. The aorta arches over the right main bronchus and ascends for the greater part of its intrathoracic course on the right of the vertebral column. In addition, they believe that the ductus arteriosus is patent. On account of the cyanosis present and on account of unfavorable home conditions which they are powerless to alter, they consider that the prognosis in this case is grave.—*R. S. Bromer.*

ABDOMEN

Blomström, H., and Sandström, Carl. On cholecystography in cases of impaired liver function. *Acta chir. Scandinav.*, 1932, *71*, 135–150.

The authors supplement cholecystography in certain cases by the bromsulphalin test which they feel gives very accurate information about the condition of the liver as by it they eliminate some of the factors that may produce absence of the gallbladder shadow. A high retention of bromsulphalin—over 40 per cent—seems to exclude the possibility of obtaining a positive shadow of the gallbladder. The absence of a gallbladder shadow on cholecystography in spite of a low retention of the bromsulphalin (below 25 per cent) shows that the obstruction is located outside the liver parenchyma. The results of this test in 68 cases as well as the technique of carrying it out are described in detail in the article. The authors have the opinion that cholecystography incurs no risk to the patient even in cases with advanced lesions of the liver.—*E. T. Leddy.*

Lepennetier, F., and Altman, M. Étude des images hydro-aériques de l'abdomen. (Study of the hydro-aerial images of the abdomen.) *J. de radiol. et d'électrol.*, 1932, *16*, 24–30.

The term of hydro-aeriation implies two distinct zones: one inferior containing liquid and a second superior containing gas. Schematically the hydro-aerial images of the abdomen may be divided into supra- and infra-mesocolic, the former being subdivided into those of the hepatic and those of the gastroduodenal region. I. Supramesocolic hydro-aerial images. (A) Images of the hepatic region. These are encountered chiefly in subphrenic abscess and in hydatid pyopneumocysts of the liver. More rarely they occur in chronic peritonitis localized to the region of the hepatic flexure or to a high loop of the jejunum and in certain forms of hepatoptosis when a bowel loop penetrates between the diaphragm and the liver. (B) The images of the gastroduodenal region. Here a distinction must be made between (1) aerophagy; (2) mid-gastric stenosis; (3) pyloric stenosis; (4) duodenal stenosis, and (5) typical diverticula. The picture of aerophagy is commonly known. The double hydro-aerial image of mid-gastric stenosis is characterized by its stability. The hydro-aeration encountered in pyloric stenosis often transforms the entire gastric cavity into a huge gas pouch. The duodenal stenosis leads to marked collection of gas above the stenosis, although this phenomenon is less frequent. It is of prime importance to distinguish between a congenital and an acquired diverticulum. The diverticular pouch, especially when filled with air, often forms in this respect a valuable criterion.

II. The submesocolic hydro-aerial images. These are encountered (A) in stenosis of the small intestine, the appearance here being quite typical, and (B) in the pathologic colon. In this latter a distinction is made between aerocoly and collection of gas in certain malformations, as for example dolichocolon, megalocolon, etc.

It is emphasized, in conclusion, that the presence of an abdominal hydro-aerial image does not acquire a real value unless associated with a certain clinical syndrome.—*T. Leucutia.*

Antonucci, Cesar. La cholécystographie rapide. (Rapid cholecystography.) *Presse méd.*, June 22, 1932, *40*, 983–986.

The author previously published in *Policlinico*, January, 1931, and again in April, 1931, his procedure for the rapid examination of the gallbladder by means of cholecystography. In this article the method is given in detail and the results obtained so far in 56 examinations are discussed.

The principle of the method is that glucose is associated with the tetraiodophenolphthalein which is injected intravenously. In the first

series, 2, 2.5, or 3 grams of tetraiodophenolphthalein were dissolved in 125 c.c. of a 40 per cent glucose solution and slowly injected intravenously according to the established procedures. The patient was prepared for a period of several days, being placed on a poor carbohydrate diet. In a second series insulin was added. The two methods are briefly as follows: (1) poor carbohydrate diet (bouillon, eggs, meat) for three or four days, then intravenous injection of 125 c.c. of 40 per cent glucose solution plus 2, 2.5 or 3 grams tetraiodophenolphthalein, and (2) injection of the solution without preliminary preparation but plus 25 units of insulin plus 2, 2.5 or 3 grams tetraiodophenolphthalein. More recently the procedure was changed so that the glucose solution is injected first and ten minutes later the tetraiodophenolphthalein solution. In case that insulin is added this then is injected after the tetraiodo by the subcutaneous route. The visualization of the gallbladder is obtained usually within half an hour following the injection, the maximum of opacity being reached at two hours. For the emptying of the gallbladder the Bronner meal can be added. It is the author's opinion that the tetraiodo necessitates the presence of glucose to be absorbed in the liver and that the dye first uses the glucose from the blood stream, determining an afflux of the glycogen from the tissues if this becomes exhausted. The glycogen is then transformed into glucose which is partly utilized by the tetraiodo and partly serves to re-establish the normal glycemia level altered by the introduction of the disturbing substance. However this may be, it appears certain from the researches performed so far that the glucose plays a great part in the utilization of the tetraiodo. With the same view in mind insulin was added so as to produce a more rapid and more complete utilization of the glucose on the part of the liver but the advantage of this latter is not proved beyond doubt. The author was also able to obtain rapid cholecystography by the addition of glycogen (10 gm.) and levulose (30 gm. in a 40 per cent solution) and more recently by various dye substances such as methylene blue (10 c.c. of a 1.1 per cent solution), indigo carmine (2 centigrams in 10 c.c.) and even by phenolsulphonphthalein (3 c.c. of a 0.60 per cent solution). In all instances the results were satisfactory, approaching those obtained by the glucose. Further experiments are in progress along this line.—*T. Leucutia.*

Sandström, Carl. De la cholécystographie par voie buccale et de sa valeur. (Cholecystography by the oral route and its value.) *J. de radiol. et d'électrol.*, 1932, *16*, 358–359.

The author recommends a new, the so-called fractionated method of cholecystography which permits a better absorption of the contrast salts, leading to a greater opacification of the gallbladder. It is known that the phenolphthalein preparations, once introduced into the system, circulate for a rather long time in an enterohepatic cycle: after being eliminated through the liver and its intermediary, the bile, they are re-absorbed through the intestine, and so on. By introducing orally during each phase of the cycle additional small doses of the salt one may obtain a more complete absorption. The author indicates two ways of applying this fractionated method: (1) The first evening 2 to 3 gm. of contrast salt (tetraiodophenolphthalein sodium) dissolved in carbonated mineral water is given, the second evening an additional 3 to 4 gm. of the salt is administered and the roentgen examination is made the day following. (2) The first evening 3 to 4 gm. of the salt is administered, the next morning 2 to 3 gm. and the same evening, the same dose is added, and the next morning the roentgen examination is made.

In discussing the technique of examination, the author emphasizes the importance of exploring the motility of the gallbladder in various positions and its sensitivity to pressure. The roentgenograms are made by placing the gallbladder under various degrees of a dosed compression. The study of the emptying of the gallbladder is likewise very important.

The fractionated method of cholecystography is entirely harmless to the patient and it has never produced a damaging action on the liver. Minute examinations of the blood and urine in normal, as well as in cases with hepatitis and cirrhosis, have proved beyond doubt that no injury was done to the liver. In analyzing the value of the method in gallbladder conditions one must bear in mind that the state of the liver cells is of paramount importance. Researches of Blomström and Sandström have demonstrated that in hepatic lesions, by using the bromsulphonthalein test, a retention as high as 30 to 40 per cent within the liver cells was observed. It is evident that under such conditions the method has very little practical value.

As a whole, cholecystography by oral fractionated doses is of extreme accuracy. It gives results which are superior to those by any other oral method and which are equivalent to the intravenous method, a fact which was also confirmed by other recent investigators.—*T. Leucutia.*

Nemours-Auguste. A propose de deux techniques cholécystographiques nouvelles. (Concerning two new techniques of cholecystography.) *Bull. et mém. Soc. de radiol. méd. de France*, Feb., 1933, *21*, 119–127.

The author presents a critical analysis of two new techniques of cholecystography, that of Antonucci and that of Sandström, which as is known have dissimilar principles in their application.

(1) The Antonucci method consists in the acceleration of cholecystography by the addition of glucose. Antonucci believes that because of the variation of the glycemia during the course of cholecystography the tetraiodophenolphthalein needs the presence of glucose to be absorbed in the liver and that consequently it will take up the glucose from the blood. When the glucose is exhausted the afflux of glycogen from the tissues follows, this being transformed into glucose which is again used by the tetraiodophenolphthalein. Chiray, Lesage and Taschner go so far as to say that the glucose excites the hepatic activity and activates the process of elimination. However this may be, it is a well-known fact that the gallbladder of diabetics fills more rapidly. The technique of Antonucci is as follows: The patient is put for three or four days on a diet free of carbohydrates. The day of examination 125 c.c. of a 40 per cent glucose solution is injected on an empty stomach. The injection lasts for about ten minutes and ten minutes later the necessary tetraiodophenolphthalein, as practiced for the intravenous method, is injected. This then is followed by the administration of 25 units of insulin which, however, may be omitted. The films are made one-half, one, and two hours after the injection, the optimum filling being obtained, as a rule, within two hours. If the emptying process is also studied the regular Boyden meal is administered. Without wishing to criticize the advantages of this method, there is no doubt in the author's estimation that it has certain disadvantages. First of all, the gallbladder may fill within two hours after intravenous injection of the dye itself without the addition of glucose. Then the gallbladder does not fill as rapidly as claimed by Antonucci. Certain gallbladders were not visible for one and a half hours and an optimum filling was not obtained until three hours after the injection. Finally, sometimes rather untoward reactions are observed following this method such as vomiting, nausea, lipothymia, etc. The author also tried the oral administration of sugar by giving 400 gm. the night before and 100 gm. the morning of the injection. The glycemia the night before amounted to 0.605 and just before the injection of the dye to 0.915. The gallbladder was visible within two hours after the injection.

(2) The second method is that of Sandström which consists in the oral administration of fractionated doses of dye. The author advised especially two procedures: (*a*) the first evening administration of 2 to 3 gm. of tetraiodophenolphthalein dissolved in soda water, the evening of the second day additional 3 to 4 gm. of the dye (according to the patient's weight) and the morning of the third day the examination; (*b*) second procedure: the first evening at 8 o'clock after dinner 3 to 4 gm. of dye dissolved in soda water, the next morning at 8 o'clock after breakfast 2 to 3 gm. of additional dye, the same evening at 6.30 after supper, which is taken at 6 o'clock, again 2 to 3 gm. of dye and the next morning at 9 o'clock the examination is made on an empty stomach. The author used the method of Sandström in 40 cases and found it very satisfactory. The only one modification that the author suggests is the partaking of 40 gm. of lemon syrup in the soda water and the advice to the patient to eat as much sugar as possible during the forty-eight hours of the preparation by following Antonucci's idea. It is the author's impression that the Sandström method with the above modification constitutes the best method of oral cholecystography. Its only defect is that it renders impossible the study of filling.—*T. Leucutia.*

Benhamou, Ed., and Marchioni, R. L'épreuve d'hépato-rétraction a l'adrénaline. (The liver retraction test of adrenalin.) *Bull. et mém. Soc. de radiol. méd. de France*, June, 1932, *20*, 388–394.

The authors, in May, 1930, for the first time called attention to the fact that the liver contracts following subcutaneous injection of ad-

renalin and that this contraction can be demonstrated roentgenographically. Since that time they have continued the experiments and now have worked out a technique which is as follows: Examination is made on an empty stomach, the patient being placed on a Potter-Bucky diaphragm in ventral decubitus, without resorting to insufflation. The normal ray passes through the mid-portion of the last intercostal space on the right side five fingers lateral from the spinous processes of the vertebrae. The roentgenograms are always taken with the patient in expiratory apnea, their number and interval varying according to the type of lesion for which the examination is made.

(1) The hepatic retraction in the normal. Following subcutaneous injection of 1 mg. of adrenalin chlorhydrate one observes a contraction of the liver on the serial roentgenograms which begins within a few minutes following the injections and which attains its peak within twenty to thirty minutes, when the retraction averages 2 to 3 cm. From the thirtieth to the forty-fifth minute the hepatic shadow remains stationary, then from the sixtieth to the ninetieth minute the lower border of the liver returns to its former position. It is interesting that the contraction of the liver runs strictly parallel with the contraction of the spleen. (2) Liver contraction in splenectomies. In subjects in which a splenectomy has been performed the liver contraction is more marked than in the normal. In one case with splenectomy following malaria the liver which was large contracted 4 cm. and the peak of contraction was reached sooner. (3) Liver retraction in cases with large non-cirrhotic livers. The authors studied successively livers of diabetics, tuberculous, hemolytic icterus and cardiacs, a definite retraction being registered in each instance which was at the rate observed in the normal. (4) Liver retraction in cirrhosis. None of these cases have shown any retraction of the liver following the injection of adrenalin.

In summarizing, the authors state that the above observed factors are interesting from several standpoints: First, they demonstrate that serial roentgenography of the liver may be used advantageously for the study of the physiologic mechanics; secondly, they demonstrate that certain large livers (malaria, cardiopathies, hemolytic icterus, etc.) behave from the point of view of function as the liver of normal individuals, and thirdly, it is the negative result of the liver retraction test which is of the greatest practical importance. This latter can be used for differentiation even in the early cases of cirrhosis, the method forming an indispensable supplement to the clinical examination of a hepatic case.—*T. Leucutia.*

Simon, Joseph. Le pyopneumocholécyste et son diagnostic radiologique. (Pyopneumocholecyst and its roentgen diagnosis.) *Presse méd.*, Dec. 21, 1932, *40*, 1938–1940.

Pyopneumocholecyst or gangrenous gaseous cholecystitis is a very rare occurrence. The author, in this article, describes a case in which the routine roentgen examination led to a most unusual picture, characterized (1) by a hydroaeric image of the biliary vesicle which was best evidenced in the standing position, the fluid level disappearing when the roentgenogram was taken in the recumbent position and (2) by the gaseous infiltration of the wall of the gallbladder, which was especially well demonstrated in the area filled with fluid, appearing as a clear border of lesser density around the fluid indicating the outline of the gallbladder. This latter sign, according to the author, is very important inasmuch as it indicates a gangrenous infection of the wall of the gallbladder in contradistinction to a fistula between the gallbladder and the intestine in which case the gas would have penetrated into the gallbladder from the bowel.—*T. Leucutia.*

Gilbert, René. Les méthodes radiologiques d'exploration du foie dans la lithiase et l'ictère lithiasique. (The roentgen method of exploration of the liver in lithiasis and lithiatic icterus.) *J. de radiol. et d'électrol.*, August, 1932, *16*, 341–357.

The author, after a systematic discussion of the various methods of gallbladder exploration such as (1) the direct method; (2) the indirect method by barium meal; (3) the cholecystographic method according to Graham and Cole, and (4) the associated method of the right upper quadrant, describes in detail his own procedure which broadly is that used by most roentgenologists. In the cholecystographic method the dye is administered either intravenously or orally and the films are made in ventral, vertical and occasionally also in profile or oblique positions, so as to note the change in position of the gallbladder. The method is always associated with a functional test, the value of which is recognized.

In discussing the problem of diagnosis of biliary calculi, the author states that he uses either the direct method or any of the others, depending on the circumstances. It is emphasized that the study of emptying of the opaque bladder may furnish differential data of prime importance.

In considering the roentgen exploration of lithiatic icterus, however, the problem is not so simple. The direct method occasionally leads to the visualization of a stone in the choledochus and the indirect method sometimes furnishes some valuable signs but it is the method of Graham on which one has to depend in most instances. There are two questions of great importance which must be elucidated first: (*a*) is cholecystography without danger in chronic icterus, and (*b*) does it furnish sufficient diagnostic possibilities? Concerning the first, one may say that if the dye is administered by the fractionated method according to Sandström (oral method), cholecystography may be practiced without danger in all cases except those with very sevère hepatic insufficiency. Concerning the second, there is no doubt that the state of the hepatic cells has an important bearing on the outcome of the test. In résumé, one may state that in case of absence of opaque choledochus calculi or of negative stone shadows within the opaque choledochus, the roentgen examination leads only to presumptions; the presence of a large gallbladder is often the result of an obstruction by cancer, whereas the visualization of gallstones is more in favor of obstruction of the choledochus by lithiasis. In this respect one must remember that the coexistence of an icteric hepatitis may simulate an occlusion cancer of the gallbladder or biliary passages occurring in 5 to 7 per cent of all cases of gallstones. The roentgen contribution based on direct signs has here a very limited value. One may hope that in due time with a better study of the functional value of the liver cells, the scope may be extended but this remains a problem of the future.—*T. Leucutia.*

Lockwood, Bruce C. Benign tumors of the stomach. *J. Am. M. Ass.*, March 19, 1932, *98*, 969–973.

Benign gastric tumors form about 5 per cent of tumors of the stomach removed at autopsy or operation. They may be fibromas, myomas, adenomas, angiomas, lipomas, myxomas, cysts or combinations of these. They vary in size from that of a pea to that of a grapefruit, being usually less than 2 cm. in diameter. Symptoms are not typical and vary with the size and site of the tumor. Diagnosis depends on thorough roentgenoscopic study with a small meal, careful palpation, and change of position. The tendency to become malignant renders early diagnosis and surgical removal important.

Three cases are presented.—*E. W. Hall.*

Holmes, George W., and Hampton, Aubrey O. The incidence of carcinoma in certain chronic ulcerating lesions of the stomach. *J. Am. M. Ass.*, Sept. 10, 1932, *99*, 905–909.

The authors review the literature and also analyze 128 records of benign gastric lesions with complete surgical and roentgen records, as well as 128 cases of benign lesions and 121 gastric carcinomas studied roentgenologically. They conclude that any chronic indurating lesion occurring within one inch of the pylorus without involving the pylorus should be considered malignant until proved otherwise, only a small percentage in this series being benign. All such lesions on the greater curvature and most of those in the fundus are malignant. The benign ulcer occurs above the antrum on the lesser curvature or at the pyloric valve. The exact location is of great importance and should be obtained by films made at various angles.

Diagnosis is often difficult from both roentgenologic and surgical standpoints. A single pathologic slide is not determinative of be.ignancy but careful serial study is essential.—*E. W. Hall.*

Shattuck, Howard F., and Imboden, Harry M. Chronic intermittent duodenal obstruction. *J. Am. M. Ass.*, March 19, 1932, *98*, 943–947.

Chronic intermittent duodenal obstruction is generally being accepted as a clinical entity though a few still hold it to be merely a sign associated with various lesions. The two most frequent and important causes are peritoneal adhesions or bands fixing the first and second parts of the duodenum and pressure of the mesenteric pedicle, a sharp occlusive angle at the duodenojejunal flexure causing obstruction of the third part of the duodenum. Not a few of the vague and indefinite chronic disturbances of the gastrointestinal tract are assignable to these causes.

Chronic intermittent duodenal obstruction

has been reported at ages varying between three and sixty-eight years. Females are more commonly affected than males, the ratio in this series of 46 cases being four to one. Over two-thirds of the series showed obstruction in the first half of the duodenum. The symptoms are variable and not characteristic. Accurate diagnosis depends on skillful roentgen study as described in this article. Most cases respond to medical treatment. In a few marked cases with short histories surgery produced striking results.—*E. W. Hall.*

Ball, Ralph G., Greene, Carl H., Camp, John D., and Rowntree, Leonard G. Calcification in tuberculosis of the suprarenal glands; roentgenographic study in Addison's disease. *J. Am. M. Ass.*, March 19, 1932, *98*, 954–961.

Authors vary as to the percentage of cases of Addison's disease which are of tuberculous etiology. In the Mayo Clinic 83 per cent of 34 necropsies on patients with this condition showed evidence of tuberculosis.

In the majority of cases destruction of the adrenal cortex probably causes death before fibrocaseation or calcification occurs. If the disease is unilateral or of long standing the roentgen study may show a calcified mass above the superior pole of the kidney. All cases of suspected or proved Addison's disease should have roentgenograms. Previous reports of calcified adrenals are unusual but 6 cases with illustrations are herewith presented.—*E. W. Hall.*

Singer, Harry A., and Rosi, Peter A. The pathogenesis of perigastric abscess complicating peptic ulcer. *Am. J. M. Sc.*, 1932, *183*, 600–608.

The belief that perigastric abscess generally follows chronic perforation is opposed by the authors. In a series of 30 cases of perigastric (including subphrenic) abscess of ulcer origin Singer and Rosi found convincing evidence of a previous acute perforation in 29. Two cases are described in detail, and the roentgenologic signs are discussed. The authors hold that the formation of adhesions about a perigastric abscess follows rather than precedes perforation. Between the time of recovery from the acute symptoms of perforation and the time of onset of manifestations of a perigastric abscess a period of fair health frequently intervenes. It is on this account that a patient often fails to associate the two illnesses or even to remember the first.—*Albert Miller.*

Åkerlund, Åke. Zur direkten Röntgendiagnostik der Dünndarmtumoren. (The roentgen diagnosis of tumors of the small intestine.) *Acta chir. Scandinav.*, 1932, *71*, 1–22.

Åkerlund shows that it is quite feasible to make a roentgen diagnosis of tumors of the small intestine at an early stage when there is neither stenosis nor obstruction of the gut. The diagnosis is facilitated by an accurate technique and a careful study of the mucosal relief of the whole bowel. Roentgen study is indicated in those cases which have persistent melena or symptoms of obstruction in whom examination of the stomach and colon are negative. The opaque medium is best administered by mouth, often supplemented by an opaque enema. It is advisable to have the patient lie on the right side for some time after the meal. For the first hour brief screen examinations are made, using a grid and firm compression by a wide belt. Serial roentgenograms are made of any suspicious-appearing finding.

The author presents a brief review of the normal roentgenology of the small intestine and refers to some of the literature on tumors of the small intestine. He next presents 4 cases of his own, all of which showed definite roentgenologic signs of infiltration but without marked obstruction (Case 1, hemangiosarcoma of the jejunum operated on with good result; Case 2, adenocarcinoma of the colon and ileum with ileocolic fistula, confirmed at operation; Case 3, adenocarcinomatosis of the peritoneum and small intestine; Case 4, lymphogranulomatosis of the small intestine).

Åkerlund divides the primary local roentgenologic signs of tumor infiltration of the small intestine into the following groups: (*a*) obliteration of the normal relief (rugae); (*b*) stiffness and inflexibility of the intestine, tenderness on pressure, palpable resistance; (*c*) filling defect; (*d*) niche formation, persistent patches of opaque substance, and (*e*) prestenotic formation of "pseudodiverticula."

In differential diagnosis tuberculous infiltration, post-ulcerous strictures, adhesions causing deformity of the bowel and even normal peristalsis must be considered. Åkerlund illustrates some of the findings of his study by reproductions of roentgenograms.—*E. T. Leddy.*

Spitz, Leonhard. Über das Mesenterium commune und den Situs inversus partialis der Bauchorgane in der Röntgenliteratur. Drei weitere Fälle von Mesenterium commune. Die Klinische Bedeutung des Mesenterium commune. (Mesenterium commune and situs inversus partialis of the abdominal viscera with respect to the roentgen literature. Three further cases of mesenterium commune. The clinical importance of mesenterium commune.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, July, 1932, *46*, 36–46.

The author adds 3 more cases of this lesion. He shows that there is no true situs inversus but that the bowel retains its original position because the normal rotation of the embryonal loop of the bowel does not occur. Mesenterium commune occurs very rarely with a true situs inversus partialis of the bowel. The author discusses the differential diagnostic characteristics of this condition and feels that diagnosis can be made only by roentgen examination and in rare cases only by stereoroentgenography.—*E. T. Leddy.*

Knittel, Gottlob. Ein Beitrag zum Kapitel normale und gestörte Darmbewegung auf Grund von röntgenologischen Beobachtungen. (A contribution to the subject of normal and pathologic movements of the bowel on the basis of roentgen observations.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Aug., 1932, *46*, 149–156.

The author feels that the large, spontaneous, peristaltic movements of the colon are to be considered as a form of peristalsis which is excited by the peristalsis resulting from defecation following the enema. The author considers some cases of irregularities of movement and points out their causes.—*E. T. Leddy.*

Kerley, Charles G. Intestinal stasis in infants and children. *J. Am. M. Ass.*, Sept. 24, 1932, *99*, 1062–1065.

There is a definite interdependence between various segments of the gastrointestinal tract. Gastric and small intestinal stasis is usually dependent on stasis in the colon. The 371 cases studied are divided into three groups. Group 1 is composed of children with an elongated redundant colon. The loops are movable except in rare cases of congenital or acquired adhesions. Group 2 includes those with muscle incoordination evidenced by circular fiber spasm and without organic lesion. Group 3 patients have as a basis for colonic spasticity some pathologic condition such as chronic appendicitis, chronic mucous colitis or mesenteric adenitis. A persistently spastic cecum is presumptive evidence of chronic appendicitis. Atropine, cascara sagrada, and dietary measures are of great value in treatment of stasis. A Bassler supporting belt is of value in ptosis.—*E. W. Hall.*

Sheldon, Luther; Kern, Richard A.; and Hakansson, Eric G. The treatment of megacolon by parathormone, with a report of three cases. *Am. J. M. Sc.*, 1932, *184*, 94–104.

In 3 cases, which are reported in detail, constipation due to idiopathic dilatation of the colon was relieved by parathormone. In one instance the treatment was effective for a year. In one patient it was shown by roentgen ray that the hugely dilated colon was reduced in eight days to practically normal size. The possible relation of abnormal parathyroid function to disorders of intestinal motility and to megacolon is discussed. Further studies are indicated to determine (*a*) the possible dangers to patients from prolonged administration of parathormone, and (*b*) the mode of action of parathormone on intestinal motor function as disclosed by clinical studies and by animal experimentation.—*Albert Miller.*

Pohl, R. Über Sekundäre Infiltrationsstenosen am Sigma bei Ovarialkarzinom. (Secondary infiltrating stenosis of the sigmoid colon in ovarian carcinoma.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Aug., 1932, *46*, 178–187.

The author reports 7 cases of infiltrating stenosis of the sigmoid secondary to ovarian carcinoma. Roentgenologic examination is important from a prognostic standpoint in that it may show that the narrowing of the gut is due to tumor, and from a diagnostic point of view in that it may show that obscure characteristics of an intestinal condition may be due to an unrecognized ovarian tumor.—*E. T. Leddy.*

Fleischner, Felix. Wandveränderungen und Stenosen am Dickdarm als Folge extrakolischer Krankheitsherde. (Wall changes and stenoses of the colon as a result of extracolic disease foci.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, March, 1932, *45*, 252–271.

The author studied the changes on the wall of the colon due to extracolonic lesions. Fourteen cases are briefly described in the text and rather profusely illustrated. It was found that the changes are chiefly the result of mechanical effect produced by pull, displacement or invasion of the colon. Secondarily, an irritative contraction leading to a permanent spasm may occur. Inflammatory and neoplastic processes of the neighboring tissues often produce, through blockage of the lymph and blood vessels (stasis, thrombosis), an edema of the colonic wall which, if the swelling of the mucosa and submucosa is very pronounced, may lead to marked stenosis of the affected bowel portion. Such a condition is recognized both clinically and roentgenologically. A differentiation from primary carcinoma of the colonic wall is made on the basis of a study of the folds of the mucosa and on the appearance of the stenosis. Thus, in edema the mouth of the stenosis appears funnel-shaped whereas in primary carcinoma the demarcation from the normal tissues is rather abrupt. If the lesion extends over a larger portion of the bowel, a differentiation from colitis may prove rather difficult. This applies especially to tuberculosis of the cecum ascendens.

A study of the location not infrequently permits certain conclusions concerning the nature of the primary lesion. Thus, extracolonic processes around the cecum originate in the majority of instances from postappendicial abscesses, those along the right half of the transverse colon from gallbladder conditions, those of the left half of the transverse colon from lesions of the stomach and duodenum, those in the region of the sigmoid from tumors or inflammations of the adnexa or appendicial abscesses, and finally, those of the rectum from Douglas abscesses or carcinomatous Douglas metastases secondary to a primary lesion of the stomach or gallbladder. Postoperative sequelae, inflammatory conditions of the omentum and peritoneum, etc., may lead to rather irregular appearances.—*T. Leucutia.*

Bensaude, Raoul; Hillemand, Pierre, and Augier, Pierre. La polypose intestinale. (Intestinal polyposis.) *Presse méd.*, April 27, 1932, *40*, 687–692.

Intestinal polyposis does not represent a single disease but a syndrome which may be subdivided thus: (1) essential polyposis due to neoformations without etiology; (2) polyposis of parasitic origin, and (3) polyposis of undetermined inflammatory origin.

A statistical survey shows that polyposis, as a whole, is exceedingly rare. Stämmler, for example, found only 5 cases in 17,000 autopsies. The authors collected 15 cases during a period of twelve years. (1) Essential polyposis. This is characterized clinically by diarrhea (5 to 8 bowel movements in 24 hours), hemorrhage, tenesmus, etc., and gives a rather typical roentgen appearance. The digital and proctoscopic examination, however, should be used to confirm the diagnosis beyond doubt. The roentgen examination, in addition to permitting the visualization of the type of lesion, gives information concerning the extent of involvement of the bowel. A simple barium enema usually suffices but in certain cases it must be supplemented with the method of impregnation of the musosal relief. The evolution of essential polyposis is fatal, death occurring within six to twelve years. The chief complications in the later stages of the disease are anemia, edemas, hippocratic fingers (described by the authors for the first time), intestinal invagination and degeneration into cancer. In 2 cases the authors observed the coincidence of polyposis with infantilism, a condition which has also been described by other investigators. (2) The polyposis of parasitic origin is encountered chiefly in bilharzia (Egypt, South America). It is also observed in a few instances of intestinal amebiasis. (3) The polyposis of undetermined inflammatory origin is found in certain cases of chronic inflammations of long duration. Thus one of the authors' cases was treated for a period of seven years with coli vaccine injections for a congestive and later an ulcerative lesion of the colon; ultimately the ulcers disappeared but small polypoid tumors the size of a small pea appeared in their places. The evolution in these cases seems relatively benign.

In the final part of the article the authors discuss the pathologic appearance and the treatment of the various types of polyposis. Concerning roentgen therapy they state that although such procedure leads to temporary improvement it does not influence the ultimate outcome.

The article is richly illustrated with roentgenograms, drawings and colored plates.—*T. Leucutia.*

Jannson, Gösta. Die Röntgensymptome bei Diverticulosis et Diverticulitis coli. (The

roentgen symptoms of diverticulosis and diverticulitis of the colon.) *Acta chir. Scandinav.*, 1932, *71*, 524–538.

The author reports with a description of the roentgenologic signs a case of diverticulosis and diverticulitis of the sigmoid with an inflammatory pseudo-tumor. He points out the different forms of diverticula, the inflammatory changes in the relief of the mucous membrane caused by diverticulitis and the signs caused by retention. Barium is often retained in the diverticula long after the colon is empty and appears as small shot-like round shadows, which finding is pathognomonic of diverticulosis.—*E. T. Leddy.*

GENITOURINARY SYSTEM

Barney, J. D., Hunter, F. T., and Mintz, E. R. The urologic aspects of radiosensitive tumors of the blood-forming organs. *J. Am. M. Ass.*, April 9, 1932, *98*, 1245–1250.

Lymphoblastomas and myeloblastomas have seldom been reported as involving the urinary tract. In the authors' study of 51 cases, 58.9 per cent of the 39 lymphoblastomas and 83.3 per cent of the 12 myeloblastomas had urinary tract involvement at autopsy and a considerable percentage had clinical signs and symptoms. These include palpable masses, back pain, retention of urine, prostatic enlargement, pyuria, hematuria and priapism. Examination should include repeated blood smears, palpation for enlarged glands with biopsy if necessary and a roentgen study of the chest and spine.

The only rational treatment is radiation therapy, the tumors being markedly radiosensitive, but the prognosis is always fatal. Abstracted protocols are included.—*E. W. Hall.*

Hellström, John. Zur Kenntnis der Ureterozele. (The recognition of ureterocele.) *Acta chir. Scandinav.*, 1932, *71*, 339–361.

The author reports 7 cases of ureterocele, 4 of which were associated with double ureters, 5 with stone and 6 with infection of the urinary tract. He regards most cases of this lesion as due to congenital malformation of the lower ureter. Intravenous pyelography is of the greatest importance in the recognition of ureterocele. Endovesical diathermy should be the routine method of treatment. In symptomless and uncomplicated cases treatment should be expectant but the condition should be watched by intravenous pyelography.—*E. T. Leddy.*

SKELETAL SYSTEM

Orr, H. Winnett. The treatment of fractures by means of skeletal devices. *J. Am. M. Ass.*, March 19, 1932, *98*, 947–951.

The modern development of the roentgen ray renders possible a more accurate restoration of anatomic contour and normal function in fracture cases. Older treatments by weights and pulleys and inefficient splints give too low a percentage of first class results. The use of skeletal traction devices including tongs and traction pins as well as direct fixation at the fracture site gives better reduction and immobilization, especially when these devices are incorporated in plaster dressings. Soft steel pins which will not break are used. Drilling has proved more satisfactory than driving pins into the bones. Dressings are usually undisturbed through the entire period of healing even in compound fractures. Much better results are claimed for the author's methods than by older methods.

Illustrations are included which show the use of pins in several types of fracture. In some cases pins are inserted even into the small bones such as phalanges.—*E. W. Hall.*

Gejrot, W. On intra-articular fractures of the capitellum and trochlea of the humerus with special reference to the treatment. *Acta chir. Scandinav.*, 1932, *71*, 253–270.

The author describes 5 cases of fracture of the capitellum and trochlea of the humerus. In 4 of these cases the fragment was made up of the anterior portion of the capitellum and a piece of the trochlea. From this results of his treatment Gejrot feels that the best results are obtained by fixing the fragment rather than by reduction by manipulation or arthrotomy. He stresses the necessity and importance of exact apposition and fixation of the fragment. If this cannot be done he advises extirpation of the fragment. The importance of roentgen examination is emphasized, and illustrated by roentgenograms of his cases.—*E. T. Ledd .*

D'Aubigné, Merle. Réduction sous l'écran des fractures de l'extremité inférieure du radius. (Reduction under the screen of fractures of the inferior extremity of the radius.) *Presse méd.*, July 13, 1932, *40*, 1106–1108.

The author describes the routine procedure for the reduction of fractures of the inferior extremity of the radius under roentgenoscopic control and he uses numerous photographs to illustrate the method. The reduction is done under local anesthesia, 10 c.c. of a 2 per cent novocaine solution being injected directly into the hematoma of the fracture. In order to obtain a good result it is necessary that the needle penetrate between the fracture ends or that at least it reach the hematoma. A valuable sign in this respect is the appearance of blood in the syringe indicating that the hematoma was penetrated.

The reduction and application of the cast is that usually used for such conditions.—*T. Leucutia.*

Rochlin, D. G., and Simonson, S. G. Über die angeborene Fingergelenkversteifung. (Congenital stiffness of the fingers.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1932, *46*, 193–204.

The authors describe a new form of congenital stiffness of the fingers which is an affection of the proximal interphalangeal joints without bony union or bone absorption. The interphalangeal spaces of these joints is narrowed, the distal end of the phalanx shows no trochlea but only a flattened joint surface which permits no possibility of motion. The deformed distal epiphysis of the phalanx ossifies by a supernumerary nucleus.—*E. T. Leddy.*

Dwyer, Hugh L. Dyschondroplasia foetalis. *Am. J. Dis. Child.*, Oct., 1932, *44*, 776–797.

Dwyer reports 3 cases, all children of one family, a boy, aged eleven, and two girls, aged ten and fifteen respectively, who presented an unusual condition of the epiphyseal cartilages, associcated with certain characteristic deformities of Ollier's dyschondroplasia. The lesions consisted of incomplete calcification of the epiphyses, most marked in the heads of the femora and the acetabula. The ends of the other long bones were similarly involved. The principal deformities were cuased by a shortening of the ulna and bowing of the radius in one arm of each of the girls, pes valgus of extreme degree from shortening of the fibula and angulation at the knee joint from small irregular epiphyseal plates at the distal ends of the femora. The cases showed no exostoses and very slight involvement of the metaphyses, thereby differing from the usual picture of chondroplasia (multiple exostoses) or dyschondroplasia (Ollier's disease).

The widened metacarpal epiphyses, the short stature and the trident hand of one girl resembles chondrodystrophia foetalis. However, the deformity of the forearm in two of these children and rarefaction of the iliac crest are classic deformities described as dyschondroplasia, and the condition presented in these children is regarded as an unusual form of this disease by Dwyer, unusual because of rarefaction of the epiphyses.

In the roentgen appearance of the acetabula and the heads of the femora, Dwyer's cases resemble the cases of dwarfism due to disordered epiphyseal development described by Morquio and also by Ruggles, but the extreme dwarfism and loss of muscular power place them, he thinks, in a different category.

Studies of the calcium and phosphorus metabolism in these children while on a low calcium diet showed slight negative balances compared with those found in normal persons. The condition is interpreted by Dwyer as an incomplete calcification of the epiphyses of growing bone rather than as a loss of mineral substance from the bone.

He uses the term dyschondroplasia foetalis in the title of this paper as descriptive of abnormal cartilage growth dating back to the fetal period. He states that the term hereditary deforming chondrodysplasia is in common use in American literature and covers all the defects of cartilaginous dystrophy resulting from a partial arrest of endochondral ossification. The most common clinical manifestation is the development of multiple cartilaginous exostoses. Dyschondroplasia or Ollier's disease may be regarded as a form of chondrodysplasia which is predominantly unilateral and characterized by cartilaginous masses situated within the bones rather than exostoses.—*R. S. Bromer.*

Karelitz, Samuel, and Kolomoyseff, H. Renal dwarfism and rickets. *Am. J. Dis. Child.*, Sept., 1932, *44*, 542–555.

The disease commonly referred to as renal rickets, renal dwarfism or renal infantilism is, as the names imply, primarily a disease of the kidneys. On the basis of a long-standing, possibly congenital renal insufficiency, grave constitutional changes occur. Dwarfism is common

to all cases; changes in the bones are seen in two-thirds of them, and infantilism is evident in patients who survive puberty.

The authors' case was observed over a period of eighteen months, and clinical, chemical and roentgen studies were made. A roentgenogram of the right forearm made in December, 1928, showed straight shafts of the radius and ulna, the cortex was of moderate thickness but lacked density, the medulla was stippled, the epiphyses were irregular and fuzzy or motheaten. There was general osteoporosis. In May, 1929, roentgenograms of the forearms showed at the height of healing: denser shafts and cortex; the epiphyses were wide and double lines of calcification were present at the diaphyseal extremities; the bones of the wrist were denser and more sharply defined than on the previous examination, before the treatment with viosterol had been begun. In November, 1929, a relapse occurred and the bones had again become osteoporotic, the cortex was thin, the medulla finely stippled and there was marked destruction of the epiphyses suggesting either fractures or subluxations. In April, 1929, ante-mortem roentgenograms showed even greater destruction and deformity. In the soft parts the arteries were visible, were somewhat tortuous and markedly calcified. At the same time a roentgenogram of the pelvis and femora showed intra-abdominal masses of calcified material, marked osteoporosis, arteries were again visible, and cortical proliferation along the shafts of the femora was easily detected. The roentgenogram of the skull showed changes suggestive of Paget's disease. Bowing and cupping were well marked on the two last examinations.

A complete history of the case with reports of all studies is given. The authors comment on the fact that this case of renal dwarfism with changes in the bones illustrates the complexity of the metabolism of rickets. The development of the latter on an endogenous basis, the occurrence of latent tetany with a blood calcium of 10 mg. and acidosis, the healing of the rickets in the presence of acidosis, the failure of rickets to respond to large doses of cod-liver oil and ultraviolet irradiation, the occurrence of rickets with a calcium-phosphorus product above 40 mg. and a drop in the product while the rickets is healing are exceptions to the common findings in infantile and experimental rickets. Various authors have offered explanations for several of these paradoxes, but further observations in similar cases are necessary to prove these explanations correct.

They suggest that all cases of chronic interstitial nephritis with dwarfism be referred to as renal dwarfism, and that the terms rickets and infantilism be added in those cases in which either or both of these symptoms is present.—*R. S. Bromer.*

Chievitz, Ole, and Olsen, Hans C. A case of generalized osteitis fibrosa improved after removal of a parathyroid tumor. *Acta chir. Scandinav.*, 1932, *71*, 172–204.

After reviewing the literature on generalized osteitis fibrosa and hyperparathyroidism the authors present their case of this disease. The patient was a woman aged twenty-five. Roentgen examination showed a pronounced osteoporosis with cysts in many bones. Biopsy made on one cyst showed a picture resembling giant cell sarcoma. The serum calcium was 17.6 mg. and the serum phosphorus 1.6 mg. per 100 c.c. Functional tests showed a lowered absorption and an increased excretion of calcium. There was no hypotonia with a lowered muscular irritability in this patient. Examination of the rest of the endocrine system gave negative results. A diagnosis was made of hyperparathyroid tumor and operation was performed. A typical parathyroid adenoma was extirpated. After operation there was a return to normal with the exception that some of the large cysts still persist eighteen months after operation.—*E. T. Leddy.*

Åkerman, J. Rapport sur les résultats des fractures de la colonne vertébrale. (Results of fractures of the spine.) *Acta chir. Scandinav.*, 1932, *71*, 23–31.

Åkerman, who is physician in chief of the State Insurance Office, gives a report on 304 fractures of the spine observed in the years 1918–1927. He excludes from discussion partial fractures of the axis, the apophyses, the sacrum and complicated lesions such as those with fracture of the skull, of the pelvis, the long bones, internal injuries, etc.

The group considered consists of 68 (22.3 per cent) cervical fractures, 102 (33.6 per cent) dorsal fractures, and 134 (44.1 per cent) lumbar fractures. Fracture of the spine (without other grave lesions) is rare. The outcome is fatal in about one-fourth (22 per cent) of the cases. Of the remainder nearly half (37 per cent) re-

covered on receiving compensation; the other half (41 per cent) are invalids, the majority for life. The death rate is higher for the cervical fractures (44 per cent) and fairly low for the lumbar fractures (12 per cent), while the dorsal fractures show an intermediate mortality (22 per cent). There is a survival of a few days (up to a week) for the cervical fractures, one month for the dorsal and four or five months for the lumbar fractures. Those who only received a compensation got well in four or five months; the compensations have been granted for nearly a year. More than a third of those who received an indemnity returned later to their usual occupation. The other two-thirds were granted an indemnity for life. The time elapsing between the accident and the fixing of the life indemnity was nearly three years—sometimes longer. The difference between the temporary indemnity and that for life is only 10 per cent so that no great improvement is to be expected in these grave cases. Of all the survivors (236 out of 304) 5 per cent are totally disabled, 20 per cent are more than half disabled and 25 per cent have received a small indemnity (10–25 per cent) for life.—*E. T. Leddy.*

LYON, ERNST. Multiple Myelome und Wirbelsäule. (Multiple myeloma of the vertebral column.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Aug., 1932, *46*, 174–178.

The characteristic signs of multiple myelomas of the spine are the absence of indentation (or a very slight one) of the contour of the bone as compared to spondylitis deformans which has a high degree of loss of bone density and general irregular deformity of the spine. Osteoporosis without any marked deformity of the vertebral column is not unusual. Atrophy of the bones is not present in spondylitis deformans and this point is important in differential diagnosis. Osteolytic processes are usually found in the long bones and ribs in most cases of multiple myeloma.—*E. T. Leddy.*

WINDHOLZ, FRANZ. Zur Röntgensymptomatologie der Ostitis deformans Paget (Periostale Knochenneubildung). (The roentgen symptomatology of osteitis deformans.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Aug., 1932, *46*, 188–193.

Windholz reports 5 cases. In the early stages of Paget's disease there was no demonstrable periosteal ossification.—*E. T. Leddy.*

IACOBOVICI, I., and ST. JIANU. Consideraţiuni asupra distrofiei chistice in legătură cu 16 observaţii. (Considerations on cystic dystrophy in connection with 16 observations.) *Cluj. med.*, Aug., 1932, *13*, 375–384.

Fibrocystic dystrophy of the bone is characterized by a generalized fibrosis of the bone marrow and by pseudo cysts and multiple tumors of the bone proper. There is a generalized form known under the name of Engel-Recklinghausen's disease and a solitary form which must be distinguished from true bone cysts or giant cell tumors of bone. In the first, the etiologic factor is a disturbance in the function of the parathyroid glands, while in the second traumatism, with subsequent hemorrhage, may be considered as the most probable provoking cause. Of the 16 cases observed by the authors, one belonged in the first group and 15 in the second. In discussing the roentgen differentiation in the solitary type from bone cysts and giant cell tumors, the authors insist on the following criteria: All three are characterized by the presence of a well-defined area of bone rarefaction with diffuse swelling of the bone and thinning of the cortex. But whereas in the bone cysts this area is more or less rounded or oval and localized in the metaphysis, in the giant cell tumors, which may be quite voluminous, it presents a very marked trabeculation and juxta-articular localization and in fibrocystic osteitis it is surrounded by trabeculae which encircle secondary cystic cavities often extending into the diaphysis.

In discussing the treatment the authors state that some of the cases may heal spontaneously following pathological fractures; others must be subjected to surgery by always using the conservative method (curettage, in rare instances, resection) and the remainder treated by radiation therapy.—*T. Leucutia.*

SVAB, VACLAV. A propos de l'ostéopoécilie héréditaire. (Concerning hereditary osteopoikilosis.) *J. de radiol. et d'électrol.*, Sept., 1932, *16*, 405–415.

In making roentgenograms of the wrist of a man, aged twenty-seven, spots of bone condensation characteristic of osteopoikilosis were incidentally observed. The same lesion was then discovered in his brother twenty-eight years of age and in his father fifty-four years of age, all of whom were suffering at the same time from diabetes. A more detailed study of the

skeleton in all 3 cases has demonstrated that the spots in the two sons were more numerous than in the father and that they involved practically the entire skeleton, except the skull. In the father the spots were observed only in the long bones of the extremities but they were associated with a disseminated lenticular dermato-fibrosis.

The author expresses the opinion that osteopoikilosis is of a hereditary nature and that the diabetes exercised an aggravating effect. In respect to etiology, he does not admit either dyschondroplasia or infection as a determining factor.—*T. Leucutia.*

Alajouanine, Th., and Mauric, G. Les cyphoses du vieillard. (Kyphosis of old age.) *Presse méd.*, Feb. 18, 1933, *41*, 269–273.

The systematic examination of the spine in old individuals reveals that the kyphosis which is so often observed after the age of seventy constitutes a definite clinical but not a roentgenologic entity. In a series of cases the authors found that the essential roentgen changes occur at the level of the discs, which maintain their normal dimensions in the posterior portion but which lead to a fusion with ossification in the anterior portion. In other instances, in addition there is a bony reaction along the anterior aspect of the spine resulting in osteophytes. There are cases in which the discs may appear normal, the alterations at the borders being primarily due to involvement of the vertebrae which appear cuneiform in shape. Finally, in one of the cases the involvement of the discs was confined to the upper portion of the kyphotic curve and the distortion of the vertebral bodies to the lower, the association of the two having led to a very marked distortion of the spine. Five cases are described briefly and illustrated with roentgenograms.

In comparing the roentgen images of the kyphosis in old people with those of post-encephalitic Parkinson's disease in the young, a great similarity is observed proving that the muscular hypertony of the antigravic muscles during the course of a pathologic process ultimately leads to the same deformity of the spinal skeleton.—*T. Leucutia.*

Gottlieb, Filip. Contribuţiuni la un semn radiologic de luxaţie congenitală coxofemurală. (Contribution to a roentgen sign of coxofemoral congenital luxation.) *Bul. Soc. de radiol. si electrol. med. d. Romania*, November, 1932, *1*, 14–19.

Normally the cartilaginous portion between the ossification nucleus of the pubic bone and of the ischium persists until the age of nine and, according to the investigations of Braus, the approximation is nearly complete at the age of five, whereas the ossification of the ischiopubic arch occurs between the fifth and seventh years. In examining several cases the author noticed that a more pronounced ischiopubic separation appears in the case of a congenital coxofemoral luxation of the involved side and that this separation continues beyond the normal age of union. This then constitutes a definite roentgen sign for the diagnosis of this condition. In reviewing the orthopedic literature the author found that Bade in 1900 and that Horvat and Vogel later called attention to the persistence of the ischiopubic separation in congenital luxation and that this fact was later also emphasized by Lorenz in 1920 and by Haglund in 1923.

The author, on the basis of his observations extending over a period of three years, is now convinced that this sign is definitely pathognomonic and that it facilitates the diagnosis of congenital luxation, especially between the ages of two and three when other roentgen signs are missing or hard to interpret.—*T. Leucutia.*

Drevon, and Mouchet, Albert. Considérations sur la scaphoïdite tarsienne des jeunes enfants. (Considerations on the tarsal scaphoiditis in young children.) *J. de radiol. et d'électrol.*, Jan., 1933, *17*, 33–40.

Each of the authors had the opportunity of reporting, in 1920, two individual cases of so-called tarsal scaphoiditis in young children. The two cases have been re-examined several times since and it is now, thirteen years later, possible to arrive at certain definite conclusions concerning the course and nature of this disease. In one of the cases it took one and a half years for the lesion of the tarsal scaphoid to heal, the bone having assumed normal appearance. In the other after a similar period the lesion healed but a slight deformity of the bone remained. In connection with these two cases the authors discuss the various etiologic theories such as anomalous development, compression fractures, tuberculosis, post-typhoid osteitis, etc. They express the opinion that in tuberculosis and post-typhoid scaphoiditis the roentgen

aspect is less typical and that, as a rule, a differential diagnosis can be made on the basis of other evidence. In the classical tarsal scaphoiditis which is associated with rather definite symptomatology such as local swelling, sensitiveness to pressure, pain upon walking, atrophy of the muscles of the leg, etc., the picture is quite typical. The lesion must until further proof be recognized as a definite clinical entity whether it be due to anomalous development, attenuated osteomyelitis, local decalcification or some other cause.—*T. Leucutia.*

Stoppani, F. Sulle fratture del II metatarseo. (Fracture of the second metatarsal.) *Diario radiol., Torino,* Jan.–Feb., 1932, *11*, 22–29.

A peculiar fracture of the second metatarsal is observed in soldiers representing a typical "marching fracture," the so-called "Fussgeschwulst" of the Germans or "pied forcé" of the French. It occurs following long marches over a rough terrain. It is most probable that the flattening of the arch under the weight of the overloaded body causes the head of the second (and occasionally of the third) metatarsal, which is in contact with the rough ground, to lock and if there is a sudden muscular contraction for the regaining of the disturbed equilibrium a fracture occurs. The author observed an identical condition in females and he reproduces the roentgenograms of 2 cases. It is his opinion that the fracture in the female must be explained on the basis of the effect of high-heeled shoes.—*T. Leucutia.*

Haglund, Patrik. Studien über die Gabelsprengung im Fussgelenk. (Studies of "fork strain" of the foot.) *Acta chir. Scandinav.*, 1932, *71*, 280–293.

The author has studied 160 cases of distortion of the tibio-tarsal joint not complicated by lesions in the bones to see whether it was possible roentgenologically to demonstrate a fork-strain (Gabelsprengung). He feels that some of these ruptures can be shown by an exceedingly exact technique. This rather common injury heals promptly by correct treatment, but if it is incorrectly diagnosed and treated it may develop into pes valgo-planus traumaticus which is much more serious. The absence of fracture must never lead one to regard these injuries as insignificant.—*E. T. Leddy.*

BLOOD AND LYMPH SYSTEM

De Takats, G. "Resting infection" in varicose veins; its diagnosis and treatment. *Am. J. M. Sc.*, 1932, *184*, 57–66.

The recognition of resting infection in varicose veins would eliminate a number of untoward inflammatory reactions following treatment by injection. The presence of a varicose ulcer does not seem to bring about such reactions, as if a local immunity had developed. The history of a previous phlebitis should force one to look for local symptoms. Tender, thickened veins, palpable phleboliths and particularly a rise in surface temperature should suggest resting infection. To activate such resting infection provocative measures such as venepuncture, diathermy or roentgen rays may be employed. The reaction is measured after four hours by the rise in skin temperature. When resting infection is diagnosed, injections should not be undertaken at that time. Obvious foci of infection should be eliminated. Repeated small doses of roentgen ray, mild protein therapy and adequate support of the limb may clear up the residual infection. Three months later the provocative tests may become negative, at which time the injection treatment is permissible.—*Albert Miller.*

Piersol, George M., and Steinfield, Edward. Granulopenia (granulocytopenia); with special reference to classification and benign types. *Arch. Int. Med.*, 1932, *49*, 578–588.

Two cases are described by the writers. In one, that of a girl aged seven, a moderate granulopenia was associated with infection of the jaw and mouth following extraction of a tooth. Under local treatment the patient recovered rapidly. Stimulating doses of roentgen irradiation to the long bones were considered but improvement began before this or injection of foreign protein could be inaugurated.

The second case was that of a woman aged forty in whom granulopenia was associated with infected tonsils which were removed, with subsequent gradual improvement. In the discussion the opinion is expressed that both benign and severe forms of granulopenia possibly have similar mechanisms. Sudden removal of older leucocytes is followed by attempts to replace these by younger forms in a more or less

orderly fashion in mild cases. In severe cases there is apparently an abeyance of granulopoiesis, or there may be a disorderly distribution with a throwing out of still more immature forms.—*Albert Miller.*

Lowenburg, Harry, and Ginsburg, Theodore M. Acute hypercalcemia; report of a case. *J. Am. M. Ass.*, Oct. 1, 1932, *99*, 1166.

This is the case of a child aged five, who received overdoses of parathyroid extract by error during treatment for purpura. For the intended dose of 1 c.c. or 20 units, an ampule of 5 c.c. or 100 units was given daily for six days. Vomiting began on the second day. On the third day there was listlessness; on the fourth severe physical depression with increased vomiting; on the fifth day lethargy was extreme and the condition considered critical. Temperature was 103°F. Hemorrhagic tendencies ceased on the second day, the clotting time changing from over two hours to about five minutes.

Hypercalcemia was suggested and blood examination showed the serum calcium to be 19.6 mg. per 100 c.c., and serum phosphorus 4.4 mg. On withdrawal of the parathyroid extract and use of intravenous saline to dilute the blood the patient became symptom-free after eleven days. At no time was there roentgen evidence of bone change.—*E. W. Hall.*

GENERAL

Barr, David Preswick. Pathological calcification. *Physiol. Rev.*, Oct., 1932, *12*, 593–624.

Pathological calcification includes any calcium deposit in the soft tissues, secretory, and excretory passages of the body, that is, all deposits except in the formation of bone. Our knowledge of pathological calcification has recently been greatly extended by studies of normal ossification, changes incident to rickets and disturbances in parathyroid function. Manifestations of pathological calcification are: (*a*) dystrophic; (*b*) calcinosis; (*c*) metastatic; (*d*) arterial; (*e*) nephrolithiasis (omitting the biliary, salivary and pancreatic duct concretions, as well as bronchial and pulmonary stones).

Dystrophic calcification, the deposit of calcium salts in devitalized tissue and unabsorbed exudates, is dependent upon local conditions and is not initiated, though it may be influenced, by general changes in calcium metabolism.

Calcinosis, the deposit of calcium in or under the skin, is of the two types: calcinosis circumscripta which is localized to the skin, and calcinosis universalis in which tendons, fascia, muscles and nerves are depositories. Several cases of the first type have shown high serum calcium while in general those of the second type have shown no elevation of serum calcium and the postulate of a disturbance in calcium metabolism with normal serum calcium is made.

Metastatic calcification seems to be due to excess of calcium in the blood stream with resultant calcification in organs showing no previous tissue damage. The kidneys, lungs, gastric mucosa and occasionally arteries and veins are the site of such deposit. The hypercalcemia is usually due to destructive bone lesions such as sarcoma, carcinoma and parathyroid tumors with general bone decalcification. Metastatic calcification is nearly always associated with nephritis. It is produced experimentally both by feeding viosterol and parathormone, and the suggestion is made that viosterol may produce its effect through stimulation of the parathyroid if administered in sufficient dosage to be toxic.

Arterial calcification of either atherosclerotic type, involving the intima, or Mönckeberg's type involving the media is rarely seen in connection with defects in calcium metabolism. One observer finds no strict localization, the demonstration of the deposit in the various coats depending on staining methods.

Urolithiasis is associated with urinary infection, stasis, and general changes in calcium metabolism. The exact rôle of hypercalcemia is difficult to determine in the case of stones containing admixtures of urates or phosphates.

Administration of calcium salts has little effect on serum calcium; parathormone greatly increases and parathyroidectomy greatly decreases it. Calcium is held in serum both in a simple solution and in combination with proteins. Calcium deposit in soft tissues bears no constant relationship to bone decalcification or hypercalcemia but is directly related to the degree of hyperphosphatemia. Solid calcium phosphate in serum and spinal fluid will remove calcium from solution. Calcium and phosphate concentration and the degree of alkalinity are of importance in solubility or precipitation of calcium salts.—*E. W. Hall.*

Feissly, R. Syncholie et synurie de quelques composés iodés.—Applications à la cholécystographie et la pyélographie. (Syncholia and synuria of certain iodized compounds: Applications in cholecystography and pyelography.) *Bull. et mém. Soc. de radiol. méd. de France*, June, 1931, *19*, 261–273.

Brugsch and Horster suggested the use of the terms of syncholia and synuria for the denomination of the mode of elimination of certain foreign substances through the two great excretory paths of the organism, the liver and kidney respectively.

The authors analyzed the mode of elimination of several phenolsulphons (phenolsulphonphthalein, 4-brom-phenolsulphonphthalein, 4-iodo-phenolsulphonphthalein) and fluoresceins (uranin, eosin, erythrosin, phloxin and bengal rose) as well as of various iodine preparations now used in cholecystography and pyelography (pyelognost, uroselectan and abrodil). It appears that of these latter abrodil gives the most satisfactory results. It must be mentioned, however, that recently Horster observed a case of very severe anaphylactic shock following the intravenous injection of this substance. In the discussion of the article, Moutard mentions that he has observed a similar anaphylactic shock following the intravenous injection of uroselectan. In his case the preliminary administration of adrenalin (which was used prophylactically) attenuated the shock, thus preventing a fatal outcome.

The conclusion is reached that the intravenous injection of the substances used for pyelography must be practiced with exceedingly great care.—*T. Leucutia.*

ROENTGEN AND RADIUM THERAPY

Gilbert, R., and Sluys, F. La radiothérapie de la granulomatose maligne. (Radiotherapy of malignant granulomatosis.) *J. de radiol. et d'électrol.*, March, 1933, *17*, 129–161.

This article constitutes an excellent monograph on the question of radiation therapy in Hodgkin's disease. It deals in extenso with the action of short radiations on the granulomatous tissue, with the effect of the therapeutic irradiations of various forms such as roentgen therapy and curie therapy, with the various procedures of therapy and the clinical control of these by especially emphasizing the effect on the general condition, blood, and skin, with the contraindications of radiation therapy, with the adjuvant therapeutic methods and finally with the results obtained, as evidenced from the statistics collected from the literature as well as from the authors' own experience.

The following general conclusions are reached: (1) Roentgen therapy is the treatment of choice in malignant lymphogranulomatosis. (2) Clinically the lesions of malignant lymphogranulomatosis are very radiosensitive. Histologically the granulomatous tissues have an inflammatory (lymphoid) character at the same time showing characteristics of neoplasm which renders them very sensitive to the rays. (3) The irradiations destroy the granulomatous tissue. This destruction is generally followed by a fibro-constructive reaction which constitutes an accentuation of a process already occurring normally. (4) It is necessary to destroy the entire granulomatous tissue. (5) Penetrating or deep roentgen therapy is chosen in preference to other methods of treatment because the penetration, distance and cross-firing permit a homogeneous distribution of the efficacious dose in the depth. Roentgen therapy permits the irradiation through large fields of rather extensive masses, a fact which is very important inasmuch as these granulomatous lesions are generally quite extensive. Curie therapy is indicated only in rarer instances. (6) The method of application of the dose plays an important rôle (time factor). Roentgen therapy in one single seance or in several seances (5 to 6 days) must be abolished. On the other hand, the fractionating should not be exaggerated and especially not too long a time should be allowed between the seances (as, for example, weekly treatments). The treatment in principle implies one single series of seances which are given daily. In practice this consists of making the diseased tissues absorb on the surface as well as in the depth a total dose of 400 r in the average cases for the first series of irradiations. (The authors administer a beginning series of a dose of 750 to 1,250 r to the skin for the peripheral adenopathies according to their volume and a dose of from 4,000 to 5,000 r for the large mediastinal tumors by giving 1,000 to 1,200 r per field of entry. The beginning dose of one seance does not exceed 200 r.) The dose is spread over a period of ten to fifteen days for each localization and over four to five weeks for a total duration of the treatment. The treat-

ment can be carried out in an ambulatory way in the majority of cases. (7) The regression of the symptoms such as pruritus, fever, pain, functional disorders, modifications of the blood formula and of the general condition must serve as guides during the treatment. The roentgenogram will greatly aid in this respect if there is invasion of the visceral organs or of the bones. (8) Radiation therapy should be directed only to lesions in a state of evolution or to recurrences. The so-called prophylactic or consolidation seances must be abolished. The patient should be kept, however, under strict surveillance and instructed on the first symptoms of a recurrence (pruritus, fever, pain, eruption, etc.) to resume irradiation at the earliest possible moment. If a recurrence manifests itself only by general symptoms (fever, pruritus, modifications of the blood formula) and no exact localization is detectable one will proceed with the total roentgen therapy with large separated fields, or with teleroentgen therapy conducted with great care. (9) Deep roentgen therapy does not exclude the administration of adjuvants such as arsenic, opotherapy, climacteric therapy and occasionally surgery. (10) A few reported and illustrated cases demonstrate the symptomatic polymorphism of the affection, the incidence, accidents and recurrences, as well as the results obtained in the cases of deep localization. (11) The authors conclude that the method of treatment as indicated above is of definite value, producing a marked prolongation of life and in very rare instances occasional cures.

A very extensive bibliography is appended.—*T. Leucutia.*

Goia, Ioan. Contribuţiuni la prognosticul limfogranulomatozei maligne in legătură cu 80 de cazuri. (Contribution to the prognosis of malignant lymphogranulomatosis in connection with 80 cases.) *Cluj. med.*, Dec., 1932, 584–590.

The author reviews 80 cases of malignant lymphogranulomatosis which have been observed at the University of Cluj since 1920. Sixty-three of these cases were subjected to roentgen therapy with the following average technique: 0.5 mm. Zn or Cu and 4 mm. Al filters; 160 to 180 kv. max., 3 to 4 ma., 30 cm. skin target distance, fractionated doses of from 150 to 200 r per field, repeated at six weeks' intervals until the lesion has disappeared, only the regions containing manifest lesions being treated.

The following general conclusions were reached: Malignant lymphogranulomatosis does not lead to permanent cure with any of the methods utilized at present. The average life duration in the 80 cases was three years and one month. In the 63 cases which died the average life duration was two years and five months and in the 17 cases which are still alive it is five years and four months. The average life duration according to the method of treatment was: In 12 untreated cases, seven months; in 3 operated cases, one died, one lived seven years and the other is still alive after six years; in 4 cases treated by neosalvarsan, four years and two months; in 46 cases treated by roentgen rays, who died two years and three months and in 17 cases treated by roentgen rays, who are still alive, five years and four months. In general the therapeutic results depend on the form of the lesion, a classification into benign, intermediate and very malignant or acute being advisable; the prognosis is more favorable in the cases which remained localized to one single group of glands or to one single organ for a longer period; in the isolated tumors of the digestive tract and in the cases without fever which show a normal leucocyte count associated with monocytosis or slight neutrophilia. Likewise a more favorable prognosis may be expected if following radiation therapy a lasting leucopenia with a prompt disappearance of the tumefactions, regression of the enlarged spleen and a return of the temperature to normal develops. The prognosis is unfavorable in case of combination with tuberculosis, involvement of the retroperitoneal glands, elevated and constant temperature, hyperleucocytosis, exudative pleural or peritoneal effusion, hyperneutrophilia, neutropenia associated with leucocytosis, hypereosinophilia and a rapid recurrence of the tumefactions following radiation therapy.—*T. Leucutia.*

Delherm, L., and Beau, H. Note sur le traitement des artérites par la radiothérapie. (On the treatment of arteritis by radiotherapy.) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1932, *20*, 526–538.

A total of 34 cases were treated by the authors, 7 of which were juvenile arteritis, 24 senile arteritis and 7 diabetic arteritis. All the cases are briefly reported. The technique em-

ployed was one which approaches that of Philips and Tunick but is somewhat more active. The radiation was directed to the paravertebral region between the tenth dorsal and fifth lumbar, medium penetrating roentgen rays, with 6 mm. Al filter being used for the purpose of cross firing; 400 R was administered alternatingly three times a week until a total dose of 1,600 to 2,000 R maximum was reached. Later additional irradiations were given over the peripheral vessels, with 2 mm. Al filter, and a total dose of 1,200 R per series, the fractionation being similar to that applied over the paravertebral regions.

Of the 34 cases treated, healing was obtained in 12, amelioration in 8 and failure in 13 cases. Generally the senile arteritis responded less favorably than the other forms. It seems that the most unfavorable factors are, in addition to the senility, the coexistence of a gangrene, absence of the oscillations in the upper third of the leg or in the thigh, lack of oscillometric modifications following warm baths and calcification of the vessels as demonstrated roentgenographically. The favorable factors are the early character of the lesion, the augmentation of the oscillations following a warm bath, the predominance of vasospasm over an organic lesion and the absence of destructive trophic disturbances. The longest healing lasted over five years. It is the authors' opinion, as already expressed, that the effect is through the sympathetic system. For this reason they prefer to call it the paravertebral or paraspinal roentgen therapy rather than suprarenal roentgen therapy.—*T. Leucutia.*

Langeron, L., Desplats, R., Cordonnier, V., and Dupas, C. Action de la radiothérapie de la région surrénale sur la constitution des cals osseux dans les anciens foyers de fractures. (Action of radiotherapy of the suprarenal region on the constitution of osseous callus in old fractures.) *Bull. et mém. Soc. de radiol. méd. de France*, 1933, *21*, 296–300.

By considering suprarenal roentgen therapy as a sympathetic and vasomotor stimulative method, it is entirely logical to try its use in various lesions of the bone which were included by Leriche and Fontaine in the group of post-traumatic vasomotor disorders such as traumatic osteoporosis. The authors applied the treatment in delay of consolidation of fractures and they now wish to report 3 cases in which good results were obtained. The 3 cases are briefly described. The radiation consisted in the administration on an average of a dose of 1000 R over each suprarenal region divided into four seances, through 5 mm. Al. The treatment was repeated for one or two series of three to six weeks intervals. The mechanism of the action of roentgen rays is probably very complicated and therefore difficult to explain. The authors, although directing the irradiation to the suprarenals are of the opinion that the effect is through the sympathetic system, which alone is capable of producing such widespread vasomotor effects.—*T. Leucutia.*

Speder, E. Vomissements dits "incoercibles" et radiothérapie du sympathique. (So-called pernicious vomiting and sympathetic radiotherapy.) *Bull. et mém. Soc. de radiol. méd. de France*, Oct., 1932, *20*, 503–509.

The author treated 9 cases of rebellious vomiting in pregnant women by irradiating the dorsolumbar region between the tenth dorsal and second lumbar with a field 20 cm. in diameter and medium penetrating roentgen rays (4 to 5 mm. Al, 95,000 volts), a dose of 500 r being administered. Only in one case was it necessary to repeat the treatment, at which time the field was a little lower, covering the suprarenals. In all instances an exacerbation of the symptoms was observed between the fifth and seventh hours following irradiation, an amelioration from the twelfth to the twenty-fourth hours and a complete cessation of the vomiting from the forty-eighth hour on. In one instance there was a slight recurrence the tenth day at which time a repetition of the irradiation over the suprarenals led again to complete cessation of the vomiting. The opinion is expressed that the effect of the irradiation is through the sympathetic system.

No definite conclusions are made as yet, the report being a preliminary one to incite further study by other investigators.—*T. Leucutia.*